MARCH 1952

PRECISION METAL MOLDING

INCLUDING DIE CASTINGS MAGAZINE

DIE CASTINGS
INVESTMENT CASTINGS
POWDER METALLURGY
PERMANENT MOLD CASTINGS
PLASTER MOLD CASTINGS

PMM

DESIGN • MANUFACTURE • FINISHING • USE

No. 2 IN A SERIES

IT'S NOT HOW MUCH YOU PAY TO GET IN

...it's what it costs to get out!

Most *a man of experience*...he took a gamble, placed his money on a long shot and while he has now learned by experience, he didn't profit by it. *Barrels are worn in the business world, too.* Success is too often gambled on a chance to obtain lower costs and quicker production instead of choosing sound operating experience.

In the casting industry there is no substitute for experience. It insures dependable production and quality at the lowest, economical end cost. For over 35 years Monarch has developed the experience that underwrites our 3 major casting operations. We have every modern facility for the practical and economical production of aluminum permanent mold, aluminum die casting and zinc die casting.

Monarch "know-how" has enabled companies in every major industry to solve casting problems . . . from initial engineering to final assembly. Monarch methods of production have been eminently successful and we are proud to say that Monarch customers are never seen "in barrels".

If you have a casting problem, let us offer a solution based on Monarch methods of production. Why not write us today?

MONARCH ALUMINUM MFG. COMPANY
DETROIT AVENUE AT WEST 93rd ST. • CLEVELAND 2, OHIO

3 casting divisions in 1 modern plant

ALUMINUM PERMANENT MOLD
ALUMINUM DIE CASTING
ZINC DIE CASTING

This Monarch Advertisement Originally Appeared in August, 1948

Its unusually significant message is even more important today...

Monarch, in one modern plant, offers completely integrated mass production facilities for quality-controlled aluminum permanent mold castings and high pressure aluminum and certified zinc die castings. Add to this the plus values of product finishing, complete product assembly and experimental development facilities, and you have a "production package" which few foundries are in a position to offer.

Monarch is ready to serve you now...with facilities, processes and specially trained personnel ...to provide practical solutions for your most complex casting problems.

Upon request, we'll send the complete "1948 series" of advertisements...also your copy of Monarch's **FACT-FILE** *for busy design, purchasing and procurement executives.*

MONARCH ALUMINUM MFG. COMPANY • *Detroit Avenue at W. 93rd Street* • *Cleveland 2, Ohio*

For additional information circle No. 35 on the Reader Service Card

A & A Die Cast & Plastic Molds Co.
Ace Diecasters
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Kamin Die Casting & Manufacturing Co.
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First names

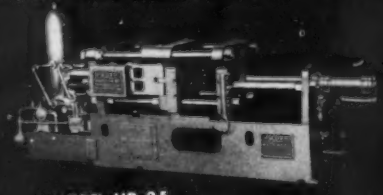
AMONG DIE CASTING JOBBERS RELY UPON

KUX

FIRST NAME IN DIE CASTING MACHINES

Here are many of the important Names among the companies that produce precision die castings to order. Whether during peace or war, these die casting jobbers are known for maintaining the highest standards of quality. Use of KUX Die Casting Equipment helps make this possible.

Continual study and improvement for over 30 years is responsible for the many exclusive engineering design superiorities that have made KUX machines the finest in their field. That's why you can be sure of maximum efficiency when you rely upon KUX Die Casting Machines.



MODEL HP-25
Cold Chamber Die Casting Machine

WRITE FOR A CATALOG TODAY!

KUX MACHINE COMPANY
6725 N. Ridge, Chicago 26, Illinois

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Plastic & Die Cast Products
Plumer Die Casting Co.
Pioneer Diecasters, Inc.
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Trilex Corp.
Tri-State Die Casting Co.
Wells Die Casting Co.
West Irving Die and Tool Co.
Yoder Manufacturing Co.

KUX

FIRST NAME IN DIE CASTING MACHINES
SELECTED BY FIRST NAMES IN INDUSTRY

For additional information circle No. 25 on the Reader Service Card

New

MILWAUKEE PLANT Offers Every Facility for Complete Die Casting Service

Founded in 1909, and a pioneer in its field, the *Milwaukee Die Casting Company* has expanded its facilities through the years to give its customers every possible advantage of the die casting process.

Now, the completion of its new plant . . . in an entirely new location with ample space for future expansion . . . heralds further extension of those basic policies which have satisfied MILWAUKEE customers for more than forty years. Here every modern facility for the production of precision die castings is included in an efficient one-floor layout to make MILWAUKEE . . . more than ever . . . a dependable source of Complete Die Casting Service.

MILWAUKEE DIE CASTING COMPANY

4146 N. HOLTON STREET • MILWAUKEE 12, WISCONSIN

A 5990-1P

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MARCH 1952
Vol. 10 No. 3

PRECISION METAL MOLDING

DIE CASTINGS • INVESTMENT CASTINGS • POWDER METALLURGY
PERMANENT MOLD CASTINGS • PLASTER MOLD CASTINGS

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All communications should be addressed to PRECISION METAL MOLDING 1240 Ontario St., Cleveland 13, Ohio Phone SUperior 1-9622. AT&T Teletype writer No. CV-233.

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Published monthly by the TECHNICAL PUBLISHING COMPANY, an affiliate of INDUSTRIAL PUBLISHING COMPANY, publishers of APPLIED HYDRAULICS, FLOW, INDUSTRY & WELDING, OCCUPATIONAL HAZARDS, COMMERCIAL REFRIGERATION AND AIR CONDITIONING. Member, Controlled Circulation Audit, Inc. Not responsible for unsolicited editorial material. Indexed regularly by Engineering Index, Inc.

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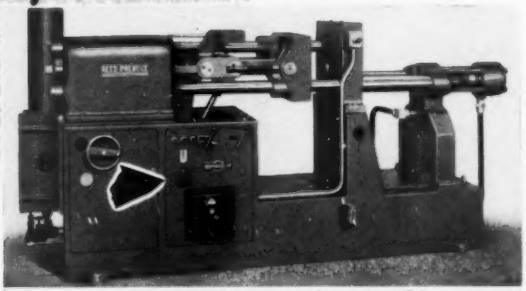
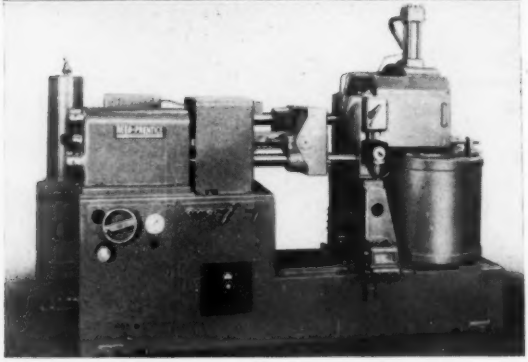
LOW COST, HIGH SPEED DIE CASTING



Reed-Prentice No. 1G Die Caster for Aluminum, Magnesium and Brass Alloys



No. 1 Die Caster for Zinc, Tin & Lead Base Alloys

IMMEDIATE DELIVERY on No. 1 & No. 1G Die Casting Machines Subject to prior sale

Fast-cycling Reed-Prentice No. 1 and 1G "Combination" Die Casting Machines provide dependable, high-speed production on small parts at surprisingly low cost. The No. 1 machine produces up to 700 shots per hour while the Model 1G "Cold Chamber" machine completes 400 cycles per hour dependent on product and die complexity. Cold Chamber unit or Furnace attachment are readily interchangeable and may be purchased separately to keep investment cost at a minimum where but one standard machine is desired. You can get the complete story on Reed-Prentice Die Casting Equipment by sending for Catalog No. 16. Why not write us today?

SPECIFICATIONS	#0	#1	#1G	#1½	#1½G	#2	#2G
Size of die plates (VxH)	10 x 10"	16 x 21"	16 x 21"	32 x 29"	32 x 29"	38 x 36"	38 x 36"
Diameter of tie bars	1½"	3"	3"	4"	4"	4"	4"
Space between bars (VxH)	8¼"	12"	12"	20 x 15"	20 x 15"	24 x 24"	24 x 24"
Die Opens	4"	8"	8"	10"	10"	14"	14"
Maximum die space	4"	14"	14"	22"	22"	30"	30"
Capacity per shot (Lbs.)	1-zinc	5.75-zinc	2.35-alum.	10.5-zinc	3.75-alum.	15-zinc	9-alum.
Net weight (Lbs.)	1,500	8,000	7,200	16,500	14,500	24,750	22,700

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REED-PRENTICE CORP.
WORCESTER MASS U.S.A.

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THESE HANDSOME NAME PLATES BY "UDICO" LEND AN AIR OF QUALITY TO ANY PRODUCT.

UNION DIE CASTING CO., Ltd.

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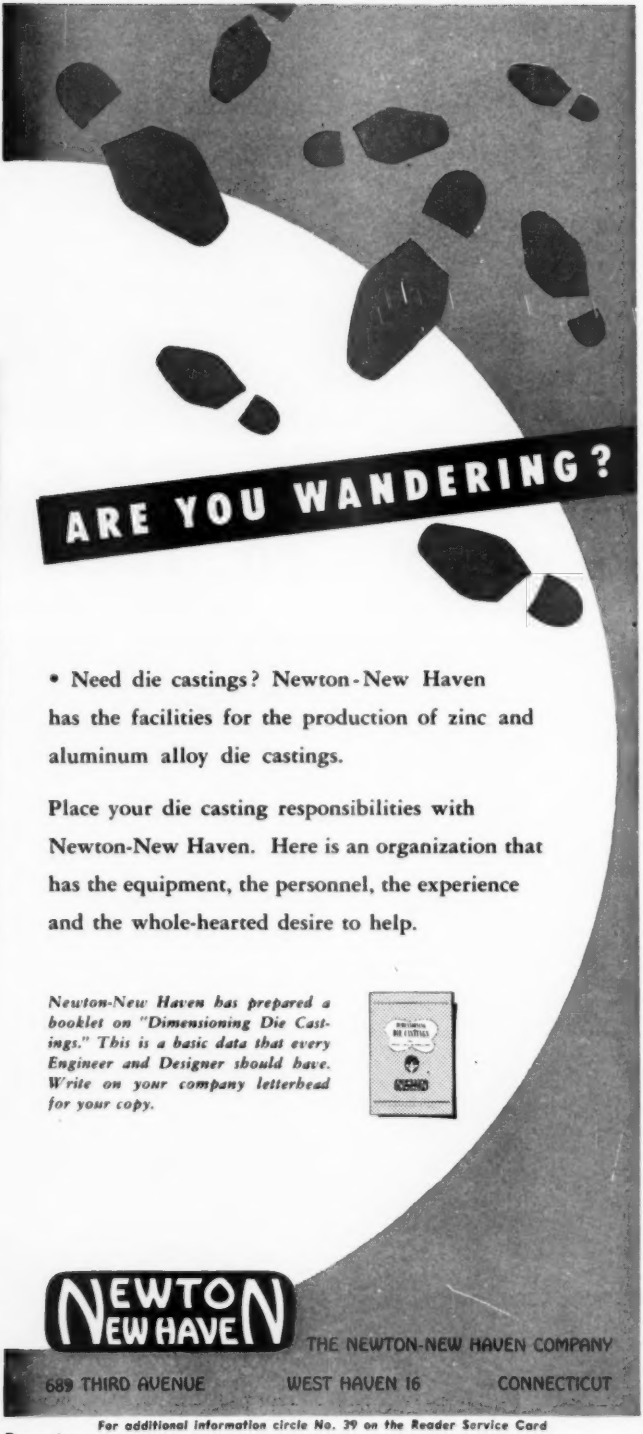
ARE YOU WANDERING?
• Need die castings? Newton-New Haven has the facilities for the production of zinc and aluminum alloy die castings.
Place your die casting responsibilities with Newton-New Haven. Here is an organization that has the equipment, the personnel, the experience and the whole-hearted desire to help.
Newton-New Haven has prepared a booklet on "Dimensioning Die Castings." This is a basic data that every Engineer and Designer should have. Write on your company letterhead for your copy.
NEWTON NEW HAVEN
THE NEWTON-NEW HAVEN COMPANY
689 THIRD AVENUE
WEST HAVEN 16
CONNECTICUT
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LETTERS TO THE EDITOR

A DIE CAST HANDLE?

We manufacture photographic equipment in considerable quantities and are constantly contacting die cast manufacturers for various parts and materials.

At the present moment, we are interested in obtaining a manufacturer who can supply us with a die cast

crank similar to that which we are including with this letter.

Please recommend to us die casters whom you believe might carry stocks of a crank similar to that which we are enclosing. — J. N.

It is not common practice among die casters to produce from stock dies, but rather to produce parts according to the drawings of specific customers, using dies which are the property of the customer. We do not know offhand of a die caster who happens to have stock dies available for handles such as you seek, but are presenting here a photograph of the handle in the event that any suppliers of die castings may be able to fill your requirements. — Ed.

DIE LUBRICANTS

Being a steady reader of your magazine, I'm wondering if I could obtain some information as to where we could get a certain die cast lubricant called "Aluminum Compound." —C. B.

This die lubricant is the product of

continued on page 10

MADISON . . . A CITY

KIPP . . . A TRADE NAME AND TRADE MARK

MADISON-KIPP . . . A CORPORATION
ESTABLISHED 1898

MANUFACTURING . . . DIE CASTINGS AND
COMPLETELY MACHINED COMPONENTS,
LUBRICATORS • HIGH SPEED AIR GRINDERS

An outstanding feature of the history of Madison-Kipp is the consistency of its services to the same customers year after year for 10, 20, 30 or more.

It has really been a case of being "departmentalized" into the organizations we serve.

This is a type of inter-company relationship that may be especially valuable to you in the near future and for for years to come.

MADISON-KIPP CORPORATION

213 WAUBESA STREET, MADISON 10, WIS., U.S.A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

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• *Skilled in* DIE CASTING *Mechanics*
• *Experienced in* LUBRICATION *Engineering*
• *Originators of Really High Speed* AIR TOOLS

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for Quality Production

AMERICAN ELECTROLYTIC

99.99+% SLAB ZINC

A reliable source for die casting requirements

AMERICAN ZINC SALES COMPANY

Distributors for

American Zinc, Lead & Smelting Company

Columbus, Ohio • Chicago • St. Louis • New York

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DIE CASTING

assures peak performance when "the heat's on"!

CASE HISTORIES FROM MT. VERNON FILES

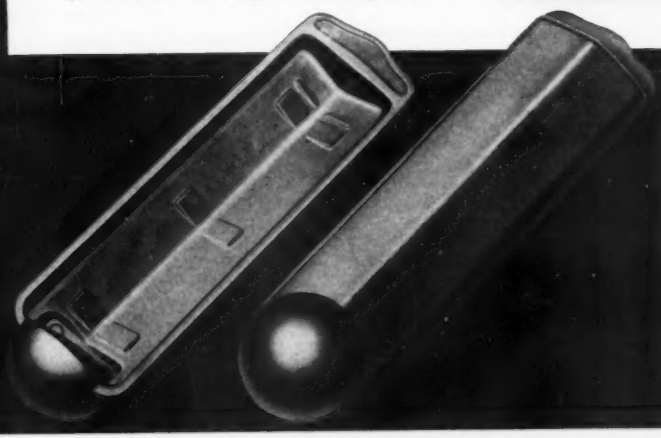
Die casting is industry's high speed producer. Not only simple parts, but really difficult ones are "naturals" for the die casting process—and they are produced fast. Yes, it *pays* to remember die casting when you're long on orders and short on time.

But that's only one angle. Die casting means savings and satisfaction whenever you employ it—actual cutting of production costs, and highly satisfactory products superior in performance and appearance.

Look at this versatile thermometer job. Moeller Industrial Thermometers required a neat-looking housing that could be easily installed in a variety of positions to suit different applications. Provision of a spherically-shaped base, which can be drilled at any angle to accommodate a tubular mount, has solved the design problem. And Mount Vernon die casting handles the production problem—by turning out these V-shaped housings rapidly and accurately; so clean that subsequent machining, other than drilling of mount hole, is unnecessary.

Whether the product you're planning to manufacture is simple or complex, it will profit you to consider die casting—and consult with us. With our long experience, specialized knowledge, and modern facilities we are in an excellent position to help you solve your production problems and give you top quality service.

MT. VERNON
DIE CASTING CORP.
MT. VERNON NEW YORK



ATLANTIC'S
MANGANESE BRONZE
Lever Casting

...VITAL PART of NEW
MANIPULATION-PROOF LOCK!

Sargent & Greenleaf's new manipulation-proof combination lock was designed to defeat the unauthorized entry of the most ingenious thieves.

One of its most important components, imparting a high tensile strength of 95,000 p.s.i. to assure absolute security against failure due to breakage, is the lever, plaster mold cast in Atlantalloy #31 Manganese Bronze.

In addition to supplying unbelievable strength, the Atlantalloy lever is essential to the proper performance of the lock because it incorporates the "fence". This projection permits the lock to be opened only by the bearer of the correct combination.

The Atlantalloy plaster mold casting process provided the lever with all necessary requisites . . . intricate form cast in one piece, and even, clean-cut surfaces held within very close tolerances.

Write for a copy of "Quality Precision Castings for Industry" today. This booklet shows how the plaster mold process cuts production costs and includes specifications on Atlantalloys.

ATLANTIC Established 1937
CASTING and ENGINEERING CORP.
721 Bloomfield Avenue • Clifton, N. J. • PRescott 9-2450
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LETTERS TO THE EDITOR
continued from page 6

Damascus, Inc., 7000 Union St., Cleveland, Ohio. — Ed.

PLASTER MOLD CASTING SOURCE

Please send us names of plaster mold casters in or near the Philadelphia area. — W.C.R.

Information forwarded. — Ed.

HIGH PHYSICAL PROPERTIES FOR IRON POWDER GEARS

I have noted with much interest the article on Page 23 of PRECISION METAL MOLDING for January 1952 on Iron Powder.

Our Major Appliance Division has been much interested in the use of iron powder as a material for gears and has had considerable success in its application.

An article which appeared recently describes powdered iron gears used in some appliances. In order to obtain adequate physical properties, these powdered iron gears have been impregnated with other metals, such as fluid copper.

We are writing to you to inquire if you know the names of firms who are in a position not only to supply powdered iron gears, but have also acquired the necessary techniques for impregnating these to obtain the high physical properties we desire. As used today, these gears have physical properties more than double what they had when we looked into them in the first place, but our recent experience has indicated that very few firms are willing to guarantee high physical properties and this has resulted in rather narrowing the source of supply.

I suggest that you have written for your magazine an article on these new high strength compositions and the metallurgy and other processes leading to their accomplishment. — C.F.S.

Names of contract fabricators known to be capable of producing infiltrated iron powder parts have been forwarded.

We agree that the future trend in the powder metallurgy field must lie in the direction of increased density

continued on page 12

Engineering Assistance and technical advice on any aluminum casting or extrusion problem is yours for the asking to help you make better use of Kaiser Aluminum pig, specification ingot or extrusion billets

▶ Aluminum pig, specification ingot, extrusion billets. Sales offices in principal cities. Kaiser Aluminum & Chemical Sales, Inc., Oakland, California.

Kaiser Aluminum

A major producer of aluminum pig, specification ingot and extrusion billets

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DEPENDABLE
BETTER METHODS
SUPER CAST
DIE CASTINGS
BETTER DIE CASTINGS
SINCE 1919

The meaning of a signature!

Through a quarter of a century of knowing how, the SUPER CAST reputation for Better Methods—Better Die Castings, has been recognized.

Sound engineering, metallurgical knowledge and skilled techniques have achieved and maintained a standard of superior quality.

SUPER CAST has kept faith, always deserving the mark it bears. SUPER CAST means die castings for those who want the best.

A sound, time-tested institution and a sound time-tested product have won confidence and widespread endorsement.

THE SUPERIOR DIE CASTING COMPANY
1001 London Road CLEVELAND 10, OHIO
Detroit Chicago Pittsburgh
Philadelphia New York

For additional information circle No. 54 on the Reader Service Card

LETTERS TO THE EDITOR
continued from page 10

with resultant higher physical properties. Considerable development work has been done, and as it becomes available, we will be happy to publish reports along these lines.

In the meantime, we wish to point out an article included in the October 1951 issue of PMM by Dr. Claus Goetzel, "Infiltration Powder Metallurgy: What It Offers the Designer of High Density Parts" in which the principles, techniques, materials and applications of infiltration are discussed.

In two major papers scheduled for our April and May issues, another phase of development work tending toward high density will be presented. Extensive work carried out by National Cash Register Company in the production of high density iron powder parts WITHOUT infiltration will be discussed. These papers will include complete production details, made available for the general advancement of the industry, as well as specific case studies of high density iron powder parts. — Ed.

ADDITIONAL COPIES OF ARTICLES

Articles in recent issues of PRECISION METAL MOLDING created much interest among us and therefore we are requesting copies of articles listed as follows: "Castings Made in Plaster Molds: the process, design factors, alloys, tolerances and advantages," by K. A. Miericke, and "12,000 PSI Yield Strength Required of Permanent Mold Casting," by Wayne Martin. — W.W.E.

Copies forwarded. — Ed.

IRON POWDER ARTICLE

We have received the January 1952 issue of PRECISION METAL MOLDING and note, with interest, the article "Iron Powder: a non-allocated metal."

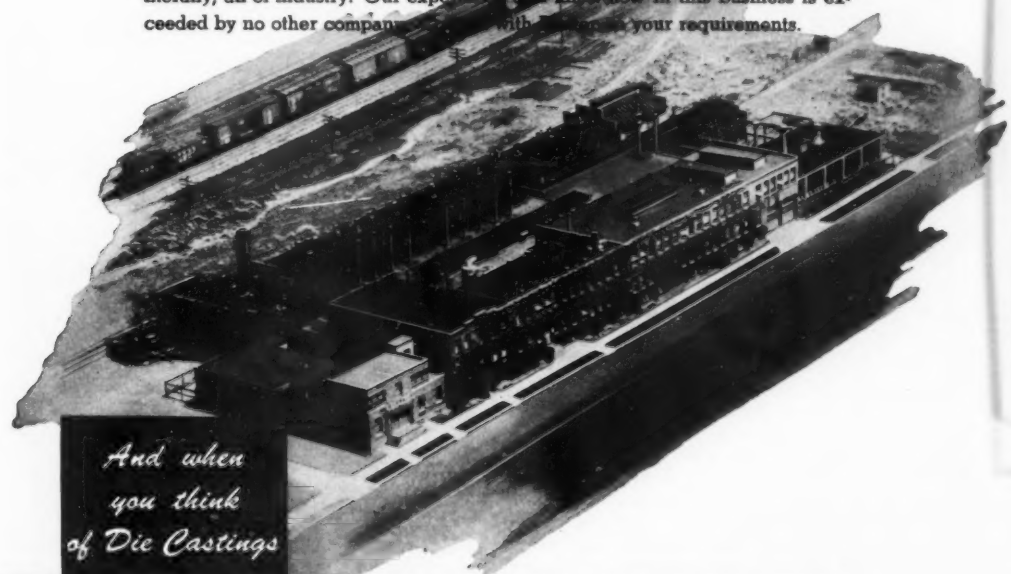
We would appreciate it if you could kindly send us five extra copies of this article. — E.C.K.

There is still a limited supply of reprints of this article which can be furnished. — Ed.

PARKER
1901 — 1951

50 YEARS of supplying quality Die Casting to all of industry!

IN 1901 William Allen Parker produced his first Die Castings. These first accurate reproductions were sold at the Buffalo Exposition that year. For the next five years more and more parts were produced and sold. In 1906 the Parker White Metal & Machine Company was formed. Since that time the Die Casting industry and Parker have grown and expanded together. Our effort here at Parker has been to produce better and better Die Castings. For a half century Parker has designed and produced parts [illegible] every industry—electrical, business machines, textile, aviation, [illegible]ware, automotive, etc.—yes, literally, all of industry. Our experi[illegible] know-how in this business is exceeded by no other company [illegible] your requirements.



And when you think of Die Castings **- - THINK OF**

PARKER WHITE METAL COMPANY• ERIE, PENNA•

PARKER ALUMINUM *and* ZINC *Die Castings*

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Complicated Castings?

H-P-M "400" Die Casters Produce them for *Mall* Tools!

Mall Tool Company reports—"Our three H-P-M Die Casters work 17 hours a day, 5½ days a week and are giving excellent service".

Mall's famous line of portable tools calls for a wide range of die castings . . . many of them complicated castings of intricate design . . . all produced on H-P-M's.

H-P-M's new Model 400-B high speed die casting machine, with built-in nitrogen accumulator, offers injection speeds up to 400 ft. per minute and produces aluminum castings weighing up to 12.2 lbs. Other design features include all-hydraulic die clamp for fast, simple die change-over . . . hydraulic ejectors . . . dual hydro-electric safety devices . . . maximum injection pressure when die is filled . . . and independent handwheel adjustment for both die clamp and injection pressures.

Discuss your die casting problems with an H-P-M engineer and profit from 75 years of specialized experience in the field of hydraulics.

SPECIFICATIONS MODEL 400-B

Size of Die Plates	Space Between Bars	Die Opens	Maximum Die Space	Capacity Per Shot (Lbs.)	Net Wt. (Lbs.)
38"x38"	23"x23"	16"	42"	2.2 to 12.2 (Al)*	40,000

**NOTE: The model 400-B handles brass and magnesium die casting as well. Complete specifications on request.*

Write for Catalog 5106, today!

HPM 75th YEAR

THE HYDRAULIC PRESS MFG. COMPANY

1094 MARION ROAD
MT. GILEAD, OHIO, U. S. A.

Builders of Presses for the Metal Working & Processing Industries • Plastics Molding Presses • Die Casting Machines • Hydraulic Pumps, Valves & Power Units

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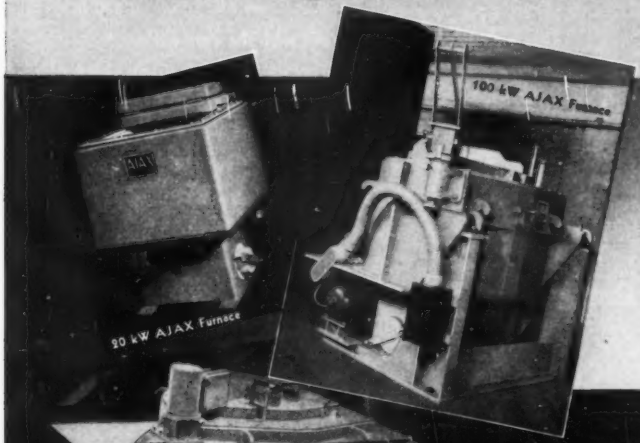
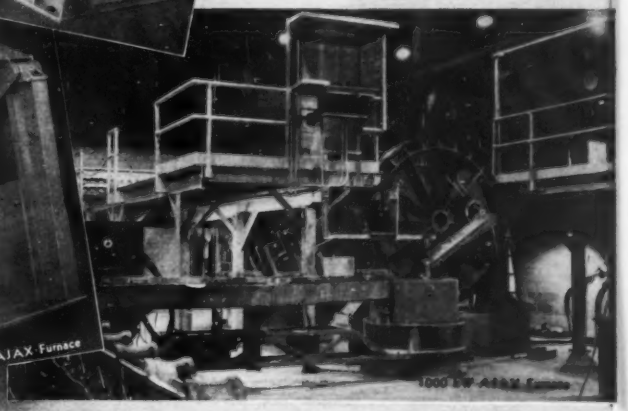
Yes! AJAX Induction Melting Furnaces are Versatile!



SOME APPLICATIONS

Die Castings
Sand Castings
Permanent Mold Castings
Scrap Recovery
Billets for Rolling and Extrusion
Galvanizing and Aluminizing of Steel
Continuous Casting of Metals



AJAX-TAMA-WYATT Low Frequency Induction Furnaces are made in a wide range of sizes, from 20 to 1000 KW, to meet demand for large volume or small special lots. They are adapted to the full range of non-ferrous metals and alloys. Their use insures faster production, uniform quality, less maintenance and lower operating cost.

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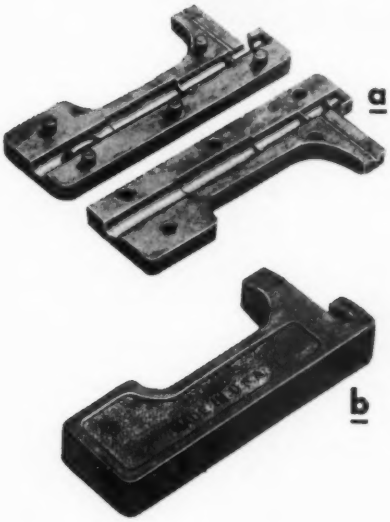
DO's and DON'Ts in DESIGNING ZINC and ALUMINUM DIE CASTINGS

examples by DOLLIN

PRINCIPLE: **For lowest final cost when two or more die castings are to be fastened together, first consider incorporating holes and mating pins as the means of assembly.**



EXAMPLE: The manufacturer's original design for this needle threader part called for fastening halves a together by means of a screw. Dollin engineers suggested the hole and mating pin arrangement shown. With tolerances for a light press fit, these halves are quickly and easily assembled b with one stroke of a punch press. Thus the extra costs of buying screws, tapping holes, and screwing the halves together, were avoided.

RESULT: Substantially lower costs for the manufacturer.

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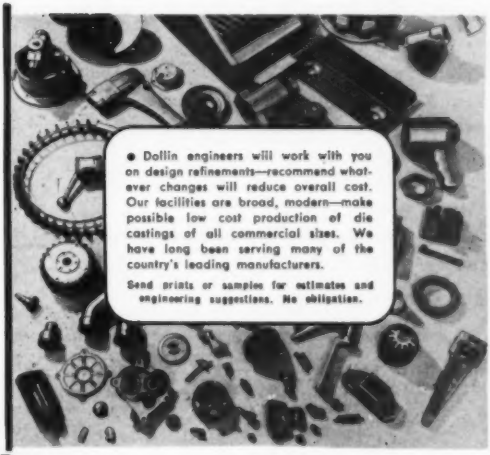

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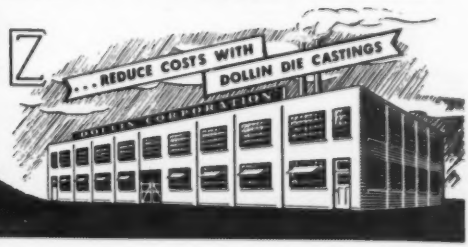

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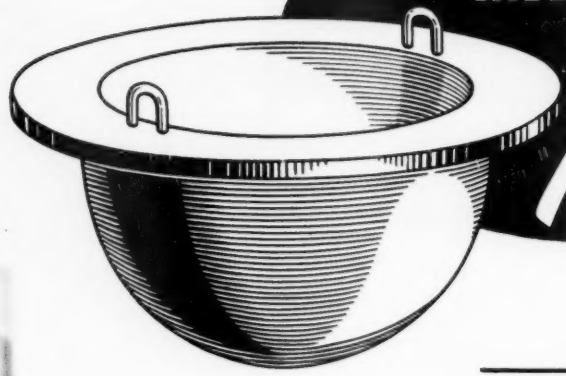

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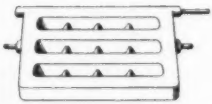

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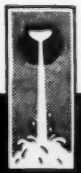

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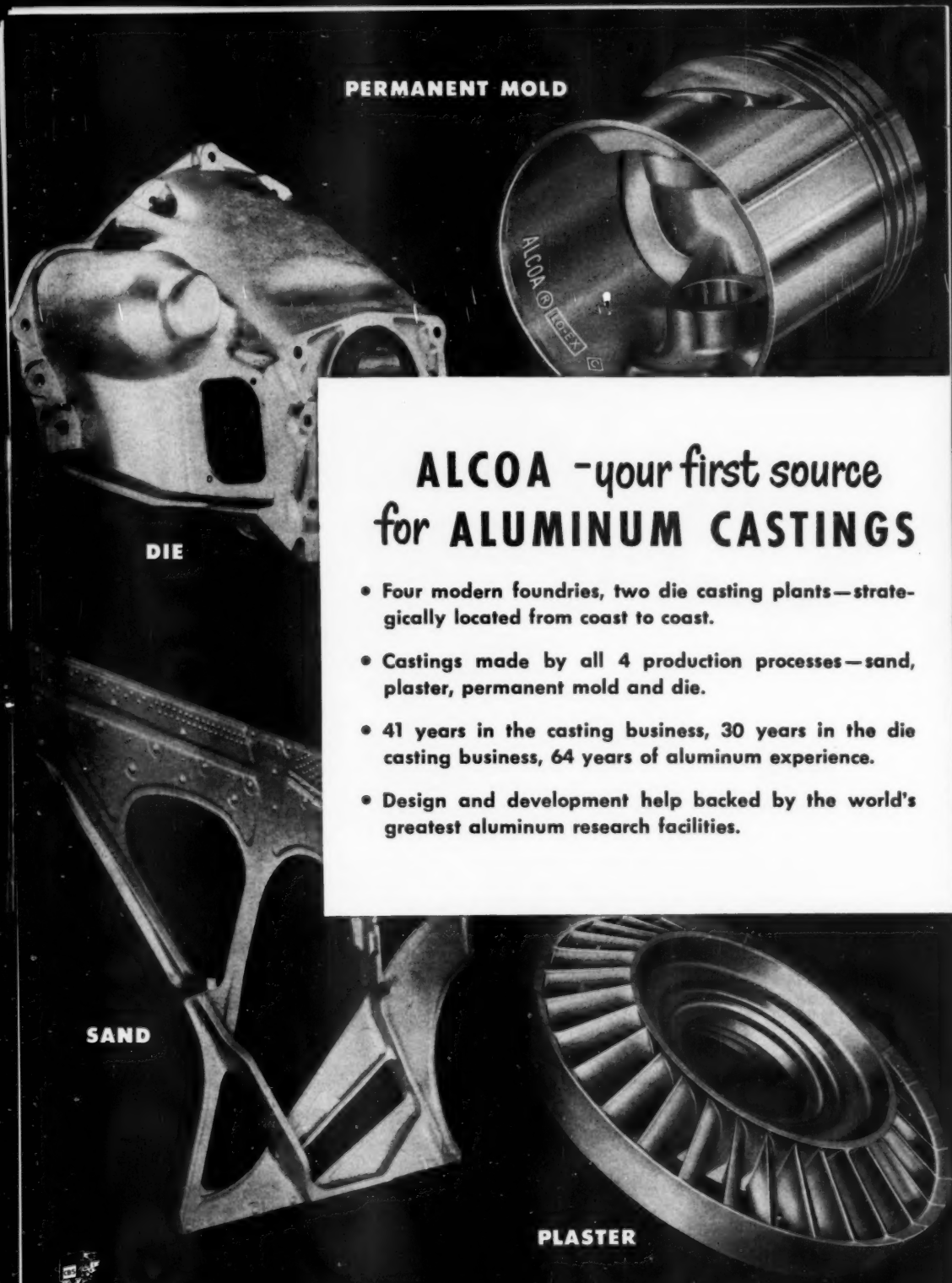

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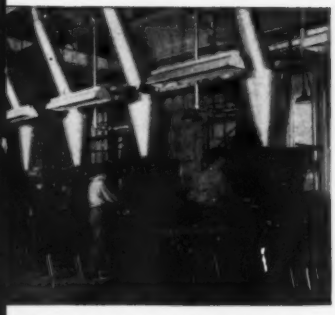
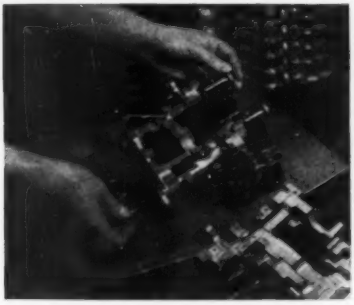


CORE MAKING—fast, high quality production of cores is assured by Alcoa's modern sand handling equipment and large capacity core ovens.

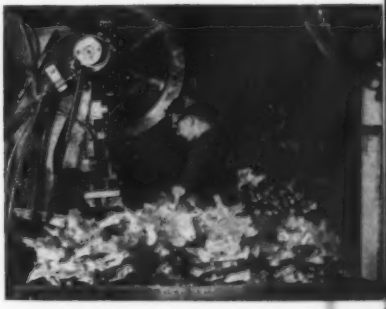
POURING TEMPERATURES—are constantly checked and recorded at control stations on all foundry floors. Procedure like this and continuous alloy control guarantee highest quality aluminum castings and die castings.

HIGH PRODUCTION CAPACITY—of Alcoa's die casting plants is partially represented in this row of cold chamber machines at Alcoa's Chicago die casting plant.

PERMANENT MOLD CASTING—formerly considered for small parts only. Today permanent mold castings weighing up to 500 pounds are not unusual.



INSPECTION—of every part is standard practice in Alcoa plants. Dimensional checks, as shown here, or visual inspection by trained personnel reduces costly rejects. Metallurgical checks further guard the castings' quality.



FINISHING—many secondary machining operations are performed by Alcoa foundries and die casting plants. Machining, grinding, sand blasting, and ball burnishing are but a few.

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"balance, 99.99+% zinc" *

DESIGNATION & COMPOSITION OF ZINC DIE CASTING ALLOYS:

	REFERENCE DESIGNATION	ALLOY 2	ALLOY 3	ALLOY 5
	NOMINAL COMPOSITION	Copper 2.5-3.5% Alum. 3.5-4.5% Mag. .02-.10%	Alum. 3.5-4.3% Mag. .03-.08%	Copper .75-1.25% Alum. 3.5-4.3% Mag. .03-.08%
ASTM	*American Soc. for Testing Materials*	*B86–XXI*	*B86–XXIII*	*B86–XXV*
SAE	*Society of Automotive Engineers*	*921*	*903*	*925*
NAVY	*U.S. Navy*		*46Z2b– Class A*	*46Z2b&c– Class B*
ARMY	*U.S. Army*		*57-93-2A Alloy A*	*57-93-2A Alloy B*
FED	*Federal Specifications*		*QQZ–363A*	*QQZ–363B*

The phenomenal growth of the die casting industry—the second largest consumer of zinc today—was chiefly provided by the development of "four-nines" metal—which is standard for all zinc alloy die castings.

Prior to 1928, the year Bunker Hill pioneered the production of "four-nines" metal, zinc die castings based on lower grade metal were restricted in their applications due to limitations in physical properties. But as soon as industry was enabled to write "balance 99.99+% zinc" into their specifications, the quality and stability required in die castings were available and the use of zinc alloy castings increased enormously. Die Casting—the shortest distance between raw material and finished product—proved the answer to industry's need for accurate, high-speed and low-cost production of the most complex parts, in a single operation, just as zinc has proved itself as the ideal base metal for die castings. Currently over 70% of all die castings by weight are made of zinc.

DIE CASTING is the Process · ZINC, the Metal · BUNKER HILL, THE PREFERRED ZINC

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2. Furnace with hood open for dipping.

3. Furnace with opening and trough for hot charging.

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STROMAN TYPE SFE MAGNESIUM MELTING AND HOLDING FURNACES

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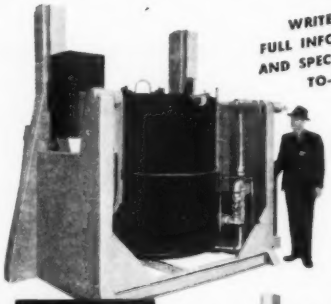

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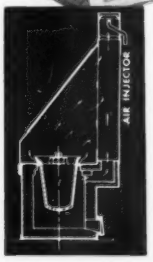
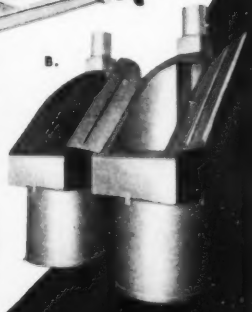


B.



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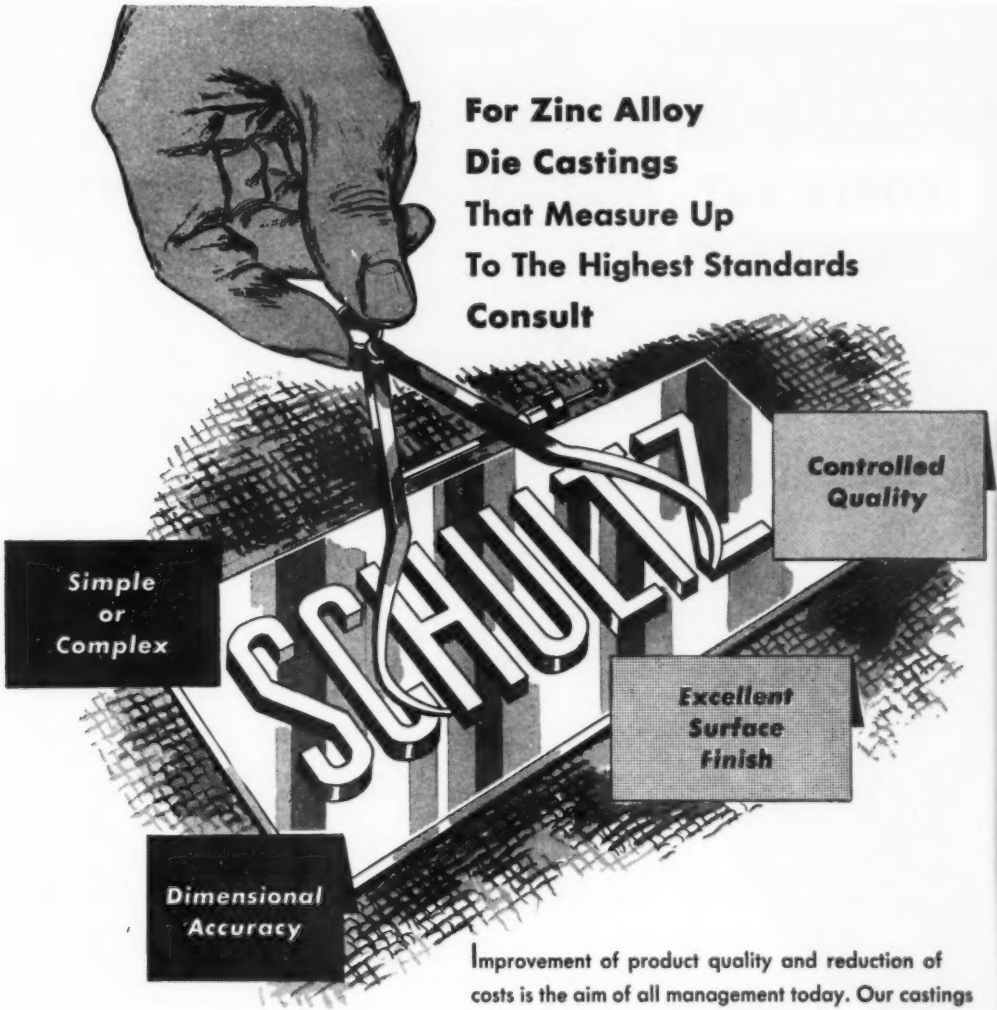

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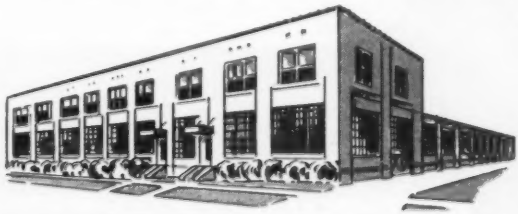

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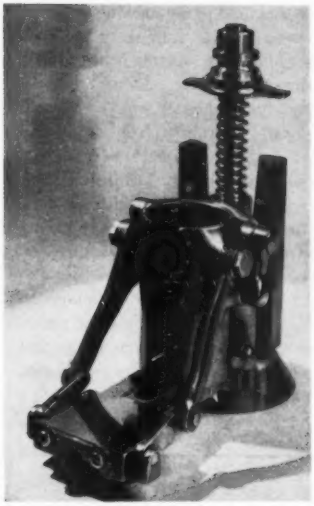
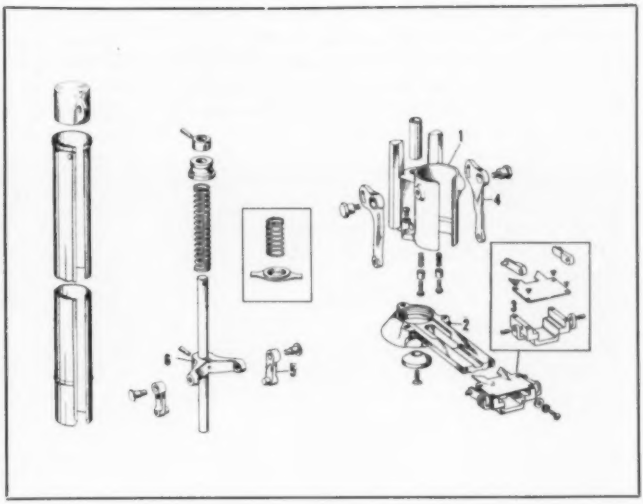


1. EASE OF CLEANING is a major consideration in the design of this milk bottle capper. For this reason, smooth-surfaced plaster mold castings in a nickel-brass alloy have been used.



2. EXPLODED VIEW reveals the component parts of the bottle capper, with the most important plaster mold castings indicated by numerals which can be identified in the text.

PLASTER MOLD CASTINGS ARE TOUGHER and smoother than sand casting of the same alloy

By T. H. KUMMER
Chief Division Engineer
Cherry-Burrell Corp.

IN spite of pasteurization, careful temperature control, sterilization of all bottles and other containers, there always exists, in the packaging of fluid milk, the danger of contamination as evidenced by an increased B-coli count during the actual bottling operation. The chief cause of contamination is stale milk condensation and other foreign matter that may cling to the surface of or in grooves, pits and crevices of the filling and capping machinery.

It is not surprising, therefore, that the chief emphasis at the Cherry-Burrell Corp. plant in Milwaukee, Wis., should be on design and redesign to improve the cleanability of their filling and capping machines.

For many years, grey iron, brass and nickel alloy sand castings were used exclusively for all parts that had to be cast. To secure the surface smoothness that was required, these castings had to be ground and polished. This grinding and polishing operation toward attainment of a sanitary surface finish, in addition to being very expensive, frequently disclosed sub-surface porosity that caused rejection.

The amount of machine work required was extensive since the sand castings could not be intricately cored. Complex jigs and fixtures were the normal order of things to make sure that all machining operations were properly indexed.

In the continual search for better and less expensive ways to make sanitary filling and capping machinery, the Cherry-Burrell Corp. has converted quite a number of their former approximately 22 percent nickel bearing copper alloy sand castings to 15 percent nickel-brass plaster mold castings made by the Universal Castings Corp. of Chicago, Ill.

Plaster mold casting has accomplished several note-

worthy savings and improvements. By far the most outstanding of these has been the improvement in surface in the as-cast condition. Where all sand castings required a grinding operation and many a grinding and polishing, the present castings are often used as received without surface conditioning.

Due to the greater accuracy of the casting operation, much tighter casting tolerances could be specified so that the amount of final machining done was in all cases materially reduced and in many cases eliminated.

Through the use of cast-in indexing points that could be located with adequate accuracy in the casting, the jigs and fixtures now needed are much simpler and less expensive than before.

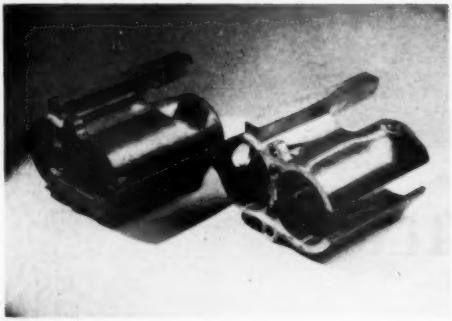
Since the plaster mold casting process is susceptible of more intricate and accurate coring than sand casting, there are many holes, slots and recesses that are now cast in where before they had to be machined.

Porous castings have become a thing of the past, even when there is a sudden change from heavy to light sections in the castings.

The micro-structure of the plaster mold castings is superior to that of a sand castings with the result that in the same alloy, a casting of greater strength and toughness is secured. An inherent feature of these castings is greater resistance to wear by sliding friction.

Steel inserts can be accurately cast in when plaster molds are used, but could not with sand castings.

While the initial cost of a sand casting was considerably lower than that of a plaster mold casting, the savings made possible by lowered machining and finishing costs have more than offset the difference so that the finished parts now cost no more, and frequently less, than the older parts they replaced.



3. POROSITY ELIMINATED IN THICK SECTIONS. The body of the capper is a part of an assembly which can be considered to be in the "milk zone" during the bottling operation. The capper body (Item 1, Figure 2) carries the supply stack of bottle caps and serves several mechanical functions. Inasmuch as the capper assembly is mounted on the filling machine to place the bottle cap on the sterilized, open-but-filled milk bottle, all portions of the body must be ground and polished so that they present a uniformly smooth surface free of pits, grooves, scratches and other blemishes which might harbor contaminants.

Both the raw and fully machined and finished body are shown. (Note that the two bodies are for different sized caps, hence the difference in inside diameter.) This part requires the greatest amount of machining and polishing of any of these plaster mold castings.

The capper body also represents one of the parts where there is a sudden change from a heavy to a light section. Sand castings of this part frequently showed porosity after the surface skin had been removed in the polishing operation. The plaster mold castings have entirely eliminated this difficulty.

The entire capper assembly is removable from the filling machine for cleaning and sterilization. These operations require handling of the relatively heavy units, together with other parts, which resulted in damaged capper parts from bending and nicking. With the plaster mold castings, such damage was greatly reduced by the better metal structure, giving a stronger, tougher casting.

4. MACHINING AND POLISHING ARE REQUIRED. A part of the capper that comes in direct contact with both the caps and the rim of the bottle is the injector slide, (Item 2, Figure 2). As in the case of the capper body, this part must be polished all over after a comparatively small amount of machining has been done. Other than a milling operation, so that the slides are dimensionally correct, the only machining done is to drill and tap five small holes and to bore the large hole through which the caps pass.

The injector slide and the body are the only parts of the capper that require polishing after they are received from the foundry. All of the other parts to be described are used as received except for minor machining operations and deburring, when necessary.

Accuracy as cast, plus special bulk-polishing techniques, cut secondary operations to a minimum

5. SPECIAL BARREL POLISHING TECHNIQUE. Components shown above are typical of a group of parts that do not come in direct contact with the milk, the bottle or the caps. They are subject to spillage and dripping, if either occurs, and hence must have smooth, easily cleanable surfaces. They are all subject to shock loading and must be strong and tough.

All of these parts are plaster mold castings of nickel-brass. One exceptional feature of these parts is that, except for minor machining, they are used as received from the foundry. The as-cast surface is not as smooth as required for this service. The Universal Castings Corp., therefore, barrel polishes them by wet tumbling in a wooden barrel that is partially filled with pulverized granite, smooth gravel and a polishing agent.

In this polishing procedure, the number of castings that can be accommodated per charge is relatively small to avoid the nicking that might be caused by castings striking together. A tumbling action is not desirable either and hence the barrel is nearly filled with the polishing media so that there is a sliding action of the granite and gravel over the surfaces of the castings. This system of polishing gives an excellent finish to the castings so that, as mentioned above, no further work is needed when they are received at the fabricating plant.

From the illustration, it is clear that both the slide block (a) and the fork (b) require a minimum of machine work to finish them.

The fork link (c) is a good example of another of the advantages of plaster mold casting. In this part, if sand cast, not only would all of the polishing have to be done and the one hole drilled, but a second hole drilled to accommodate the steel pin. As plaster mold cast, however, the steel pin is cast as an insert, thus saving the work needed to drill and secure it in the casting.

The side lever (d) illustrates how plaster mold casting can reduce finishing expense. The small hole in the end of the lever must be fairly accurately positioned with respect to the larger hole in the other end. Normally after the larger hole is reamed, the part would have to be clamped in a jig to position accurately the smaller hole. By casting in an index point which is positioned by the master pattern, it is not necessary to have a drill jig. The position of the hole is closely enough marked for the purposes and only a holding device is necessary for this drilling operation. Furthermore, the milling operation of the elongated slot was eliminated by plaster mold casting.

One other plaster mold casting that is worthy of particular note, is the slide catch bracket. When sand castings were used for this part, breakage of the casting at the mounting holes occurred frequently due to the repeated bending-shock stresses to which the part is subjected. Without any redesign, the plaster mold casting has stood up perfectly in this service due only to the better strength and greater toughness of the casting and consistent casting dimensions which were not altered—as with sand casting—because the grinding operation was eliminated.

For stainless steel parts having irregular contour, Cherry-Burrell uses INVESTMENT CASTINGS

6. IN MANY CASES the operational characteristics required of a machine part fix the design rigidly. In those cases, the engineer is faced with the problem of how to fabricate the part rather than being able to adapt the design to well-known methods of production.

Fortunately, the rapid growth of PMM processes in the past few years has put in the hands of production men a group of processes that have immeasurably widened the field of low cost manufacturing procedures.

Some of the parts of the sanitary filling valves on the Cherry-Burrell bottle fillers are good examples of functional characteristics dictating complex design and, in this case, the solution of a tough fabricating problem found in investment castings made by the Microcast Div. of the Austenal Laboratories of New York, and the Allis-Chalmers Mfg. Co. of Milwaukee, Wis.

The vent tube stabilizer shown at (a) below is a typical part, the manufacture of which would be both difficult and expensive by any standard shop methods. While a sand casting could be used, the machining, grinding and polishing costs would be excessive. Since the part must be stainless steel, it cannot be plaster mold cast or die cast. Machining from bar stock would be excessively wasteful of material and very costly. As investment cast, however, the stabilizer requires only boring the ID. While this dimension could be held more closely to finished size than it is by the foundry, a final grinding and reaming operation would still be necessary and manufacturing economy showed that giving the foundry more open dimensions and doing a little more machine shop work, the final cost of the part was somewhat lower.

The inner valve rod plug shown at (b) below is still another part that required a definite shape to function as desired and which would be excessively costly to machine. Other than to cut off the sprue and to drill one hole 0.1065 inches diameter, the plug requires only polishing after being investment cast in 303 stainless steel. Since this part is relatively small, tolerances as low as $\pm$ 0.002 are held by the foundry.

Other examples of investment cast stainless steel parts that present difficult, if not impossible, machining problems, but are simple to cast, are illustrated below.

The actual savings achieved by the use of investment casting as contrasted with other methods of fabrication for these particular parts are evident. They were designed originally to be made by investment casting. It is, however, fairly obvious that to machine from bar stock, finish a sand casting, or assemble by brazing or silver soldering, machined components would be too costly as was proved by the fabrication of pilot lots of experimental parts.

By experience, it was found that the new foundry processes of precision casting by plaster mold and investment methods have given a practical approach and wider avenue of creative design for specific requirement to be produced economically when older methods of manufacture posed insurmountable problems.

A review of FACTORS INFLUENCING THE USE OF PERMANENT MOLD CASTINGS

INTERMEDIATE between sand castings and die castings in some respects, permanent mold castings have their own range of economic usefulness which is not fully appreciated by many product designers. Accustomed to thinking of permanent mold casting only as a means of producing cooking utensils, automotive pistons and washing machine agitators, the design engineer too often overlooks the potential advantages of this process for obtaining the functioning, mounting or housing components of his own product.

The advantages as well as the limitations of the process are inherent in the casting technique involved, and a brief comparison of permanent mold with sand and die casting will illustrate this. The fundamental characteristics of permanent mold casting are the metal mold and the gravity pouring of molten alloy. It differs principally from sand casting in that it uses a durable, non-expendable mold rather than one of sand; it differs from die casting principally in the use of gravity rather than pressure for pouring.

The effect of molding method on end result

Thus, the permanent mold casting derives an advantage over sand casting which can be traced directly to the iron or Meehanite mold: the castings are more accurate, surfaces are smoother and production rates can be more rapid. Conversely, there is generally a higher initial tool cost of permanent mold castings. This investment in tools is reflected in amortization of die cost which can rarely be justified with production quantities less than 500 pieces, but is a negligible factor when written off over a larger production run.

Characteristics of gravity and pressure castings

On the other hand, although both die castings and permanent mold castings are formed in metal cavities, the manner of filling results in two entirely different types of chilling action. Greater refinement of grain, and increased density in heavy sections are two outstanding characteristics of permanent mold castings resulting from the gravity technique of pouring. However, the manual pouring and slow rate of chill also have the adverse effect of retarding production rates considerably, as compared with the rapid cycling of die casting machines.

The type of cavity and auxiliary equipment used for permanent mold casting, even when hydraulic clamping, ejection or core pull is employed, is much simpler than that usual for die casting. Thus, where the close dimensional tolerances obtainable from die casting are not needed, the tool cost required to get into production may favor the permanent mold casting, especially for moderate quantities of pieces.

The product designer must determine which aspect of the casting are most essential to his product in each case, and base his selection of a process upon these factors. Questions he might well ask himself in making a choice among sand, permanent mold or die casting for a part to be formed in aluminum or magnesium should include:

- What quantity of pieces will be required annually? How many pieces will be required on a day-to-day basis to meet current production needs without exceeding sound inventory limits?
- How close must dimensions be held? Where do the dimensions occur in relation to the mold parting and cores? How many close dimensions must be cast and how many may be machined?
- What physical and metallurgical requirements must the part meet? What are its conditions of service?
- How large are the pieces? What wall thicknesses are involved? How complex is the shape? How much surface detail is called for?
- What type of surface finish is required?

In considering permanent mold castings, some of the following generalizations will perhaps help the designer in making his choice; it should be pointed out, however, that there are exceptions to each of these generalizations, both on the positive and

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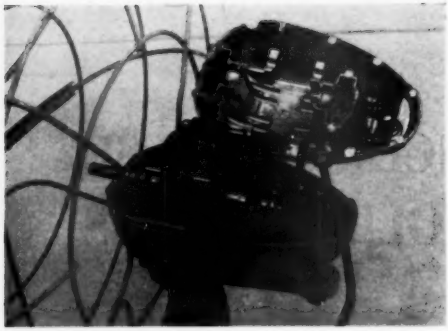
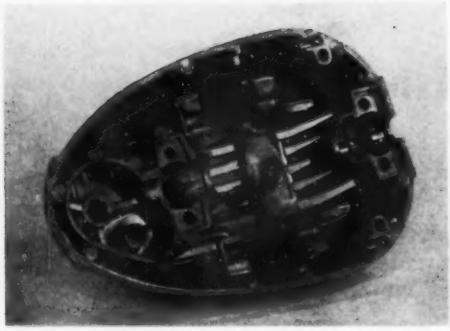


1. DESIGNED LIKE "A PENCIL LAID IN A TRAY," this housing for a fan motor is arranged so that the preassembled motor unit can be placed into position and automatically aligned and held in position.



2. EASIER TO SERVICE, this motor shell has everything necessary for accurate mounting and location formed in this zinc die casting. This is thorough use of the advantages of the die casting process.

TO TAKE FULL ADVANTAGE OF DIE CASTINGS, Westinghouse has redesigned its fan motor housings

ALL too often in designing parts to be die cast, the engineer tends to stick to sterotyped design only because the part has always been made in that way before. This wearing of blinders, as it were, can and often does lead to a finished product that fulfills its job functionally, but has failed to take advantage of the high degree of versatility inherent in die casting. To make the most advantageous use of die casting may mean that the design engineer must depart, and often radically, from the orthodox ways of thinking and doing. The normal tendency of human nature is to resist change so that a new and different approach to an old problem generally has a long uphill fight against entrenched thinking.

From stereotyped motor design . . . .

The horizontally split motor housing used by Westinghouse Electric Corp. on their circulating fans and food crafter was one of the cases where a change in thinking resulted in a better product and a lower manufacturing cost.

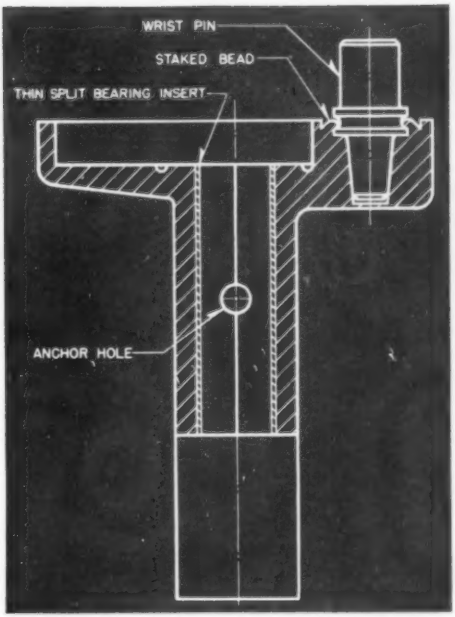
A die cast motor housing is not new. Particularly since the war when a shortage of grey iron developed, many motor manufacturers have converted to die castings particularly for the end bells on fractional horse power electric motors. These housings have followed, almost exactly the design of the part they replaced. The stator laminations were pressed into one casting, the rotor inserted and the end bells fitted. The entire assembly was held together with four long studs. In the case of a ventilating fan, the fan guard was almost always held in place by the same studs that were used to bolt the motor housing together.

When the motor had to be serviced, disassembly was difficult and even minor repairs or adjustments required that the entire motor be torn down.

to horizontally-split motor shell . . . .

Westinghouse engineers felt that a small motor could be developed which could be serviced and adjusted more easily and which would be at the same time, faster and cheaper to manufacture. Discarding all of their

3. CAST IN OR PRESSED IN: two inserts are used with the die cast zinc fixed member of the oscillating mechanism, **above.** The split sleeve, **left,** is cast as an insert and anchored by the hole in its side: the wrist pin, **right,** is pressed in and the die cast flange is rolled over to hold it.



4. TWO WAYS TO ANCHOR AN INSERT are illustrated by the section drawing, **above.** Both methods of holding are employed to gain the maximum value of the characteristics of the die casting process.

preconceived notions about motor design, they set out to achieve the unorthodox, to build a motor in which a complete assembly could be laid in the housing as easily as a pencil is laid in a tray. This conception immediately implied that the housing would have to be split along a plane parallel to the shaft and passing through the axis of the shaft. Here, then, was the first major departure from the conventional.

From this starting point, it became obvious that if a complete motor assembly was to be laid in one-half of the motor housing, then the housing must have in it all of the necessary lugs, bosses, seats, etc., that would be required to adequately support and later hold in position all of the fixed motor components.

The housing should further be capable of supporting any auxiliary parts, such as a fan guard, without having to use additional fastening devices.

The result of this thinking is shown in Figures 1 and 2. The motor housing is only two pieces, both of which in the case of the fan are aluminum die castings. As can be seen from the illustrations, every seat and supporting member that is required to amount and align the motor unit is cast in.

The most immediately obvious point is that the fan motor can now be assembled completely before it is placed in the housing. There is no need to utilize any separate or special fastening devices of any sort. Even the worm for driving the oscillating mechanism may be a part of the motor assembly. After the motor is in place, the fan guard may be put on and then, after the complete assembly, the cover casting is bolted in place.

. . . . which permits preassembly of the motor.

Since the lower motor housing is depended on to align all of the components, it must be held to dimensional tolerances closer than can be easily met by die casting. Rather than go through a large amount of complex machining, the design is such that the die cast surfaces can be used in all cases and the *alignment is*

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IBM: major user of metal powder parts*

ONE of the outstanding users of small parts made from metal powders is the International Business Machines Corp. at Endicott and Poughkeepsie, New York. Over the past ten years the use of these parts has been steadily expanding from a few self-lubricating bearings at the start to over 800 parts now being used. This continually increasing use of powdered metal parts is evidence of the superiority of powder metallurgy as a fabricating method, "when it is intelligently applied."

IBM engineers recognize three general reasons for the use of powder parts:

- Certain properties such as controlled porosity cannot be secured by any other fabricating method.
- Desirable shapes can be made by powder techniques that are outside the scope of ordinarily obtainable machine tools.
- Finally, when sufficiently large quantities of a given part are involved, the cost per unit may be materially lower using powder metallurgy as a fabricating method.

IBM, through years of use, has found that on business machines a few generalizations can be made regarding the application of powder parts. Some small gears are less costly and better if made from iron powder than their wrought and machined counterparts. Some cams made of brass, bronze or iron powders are preferable to cams machined from bar or plate stock. So-called self-lubricating bearings and bushings will normally outperform bearings made from bronze bar stock and in many cases are less costly and better than ball or roller bearings.

On the other hand, there are some features about powdered metal parts that create design and processing problems. Parts made from metal powders should not be used where they are subject to shock loadings or where high tensile stresses may be encountered. Iron powder parts, even when oil impregnated, require a special surface treatment to secure the best corrosion resistance and the best oil retention properties. Iron parts which are to be hardened may be troublesome. Where uniform hardening through the piece is desired, a powder part will generally respond adequately though it may require different treatment than wrought steel. On porous parts, salt bath hardening can leave deposits in the pores that result in corrosion at a later time.

When a part is to be case hardened, experience has shown that it is difficult to secure uniform case depth. This is particularly true of those pieces made from a mixture of iron and copper powders. This does not imply that both full hardening and case hardening cannot be done, only that it may be more difficult on powder parts.

Surface finishing of powder metallurgical products is generally difficult when an electroplated finish is desired. Only those parts having a low initial porosity or which respond to a surface burnishing treatment plate successfully. For iron parts, blackening processes are available that are highly successful.

With these few generalizations in mind, it will be well to examine a few typical parts used by IBM in their various machines. For the purpose of this review, all bearings and bushings, except for one special sleeve bearing, have been disregarded. The other parts chosen are thought to be typical of the uses made of powder parts and exemplify the reasoning which underlies their

*This is the third of five articles by P. R. Kalischer, associate editor of PMM, on the use of iron powder parts. Subsequent articles will be presented on high density iron parts, and a review of specifications for powdered metal parts at IBM.

Smoother blending of camming surfaces with iron powder cam

The clutch engaging cam, Figure 1, is typical of the IBM parts made from iron powders and then case hardened. To make this part from bar stock required machining, broaching the shape, then case hardening and grinding.

To secure the operational characteristics desired, the circular face had to be held to a concentricity tolerance with respect to the bore of 0.002 total indicator reading. Further, the curved faces of the lobes had to blend into the flats smoothly to avoid jerky operation. When the cam was machined from bar stock, the concentricity tolerance was readily met but the final grinding operation would not give the desired smooth transition from the curved to the flat surfaces.

Use of powder metallurgy for fabricating this cam gave the same tolerance as far as concentricity is concerned. Since a large quantity of these parts are used per year, it is obviously impossible to depend upon hand work to secure the smooth blending of surfaces. It was, however, quite feasible to work the desired curve into the molding die so that the powder part had the contour desired.

As mentioned above, this part is case hardened. Since the powder mix contains some copper, it has been found that non-uniform case depth results. However, the resulting case depth is sufficient for satisfactory operation of the part.

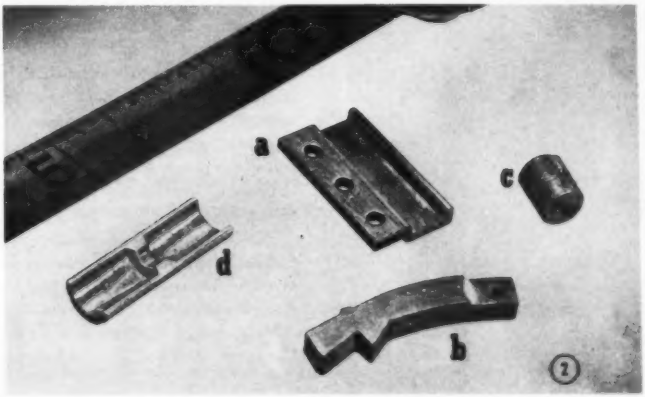
The original design of the cam required a needle bearing. When the part was changed to one made of iron powder, the needle bearing was no longer required since the cam could be impregnated with oil and thus act as an adequate bushing in itself. Prior to the final oil impregnation, these cams are given a steam treatment which applies an adhesive oxide film to the metal particles.

The cost of producing this part from metal powders is about the same as the former machined cam, but, since no needle bearing is required, the assembly ready for installation is somewhat less costly when made from powders.

Four applications illustrate reasons for using powder parts

SELF-LUBRICATION FOR HARD-TO-REACH PARTS. It has been pointed out that one of the reasons IBM engineers use powder metal products is to take advantage of the self-lubricating features made possible by controlled porosity of powder parts.

The intermediate guide, 2-a, is an example of such



a part. By fabricating the guide of iron powder with controlled porosity and oil impregnating before installation, the guide functions satisfactorily with a minimum of attention.

This part is a good example of direct substitution by a powder part without any redesign or modification being necessary and illustrates how the use of powder parts can give the designer increased flexibility of material.

Plated brass part shows major cost reduction. Discounting self-lubricating bearings, the most prevalent reason for using powder metal products is cost reduction. The escapement lever, 2-b, is only one of the many parts used by IBM where cost reduction is the only consideration. This lever is molded from brass powder and is received from the vendor completed and ready for plating. The reduction in cost as compared with blanking, trimming and machining as previously practiced is over 50 percent.

There is no other good way to do it

Some parts can be pressed from metal powders, but cannot be produced economically by any other method.

The brass bushing, 2-c, is an example of such a part. This bushing acts as a punch guide and twelve guides are used per assembly. The guides are placed on the punch and after positioning are molded in soft metal mountings.

Accuracy of the rectangular slot and precise dimensional tolerances make this piece exceptional. Both dimensions on the slot are held to a total tolerance of 0.002, probably one of the closest jobs being currently produced by the powder process.

Bushing costs reduced over 90 percent

A split bushing with a non-uniform bore is shown in Figure 2-d. About the only method of manufacture besides powder metallurgy is to drill bar stock either before or after splitting. This method was tried but on the best automatic machines available, the cost was prohibitive.

Conversion to brass powder gave a bushing that meets all of the required dimensional and physical standards at a cost reduction of over 90 percent.

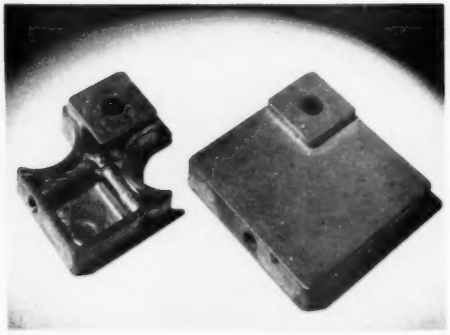
Powder cam gives better performance

Typical of the many powder metal cams used by IBM is a split impulse cam, not shown. It is quite possible to make this cam by standard machining methods, but they would fail to give cams that are consistently smooth and uniform in operation.

The part is, in addition, rather heavily loaded so that some sort of lubrication is required. By making the cam of iron powder, the camming surface can be completely uniform from piece to piece and has the further advantage of being porous so that it can be oil impregnated and thus made self-lubricating.

This piece is probably no cheaper made out of metal powders than when machined from wrought stock, but its superior performance is sufficient reason for the use of iron powder.

How a $400 investment produced $1850 per year saving . . .



MANY A DIE CASTING, now in production could readily be redesigned to reduce the amount of metal consumed and thus serve two purposes at once: conserve scarce natural resources to aid in national defense, and reduce piece costs.

An excellent sample of such redesign of a zinc die casting is the corner block illustrated at the left. Increased costs of metal and labor over the past five years made the original 1½-inch square block too expensive and so the Union Die Casting Company of Los Angeles, California, worked together with its customer to redesign the part.

The new design is illustrated, next to the original, and it is apparent that considerable metal has been saved by hollowing out the block, but leaving sufficient metal for strength.

Metal weight has been reduced from 2.062 ounces to ⅝ ounce (.6250) with a resultant cost saving of $1.850 per year to the customer on a $400 tooling investment.

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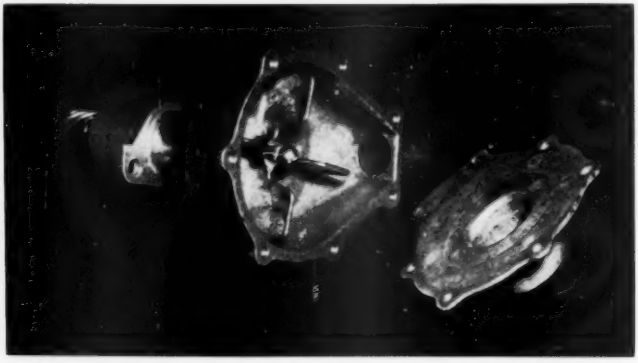
in the presence of soap and detergents

IN the design of washing machines, the engineer is faced with problems not encountered when designing non-consumer goods. That the machine must do an adequate job of getting clothes clean is an elementary principle, but it must also last almost indefinitely with practically no maintenance. All parts in contact with water must be able to withstand any unusual and all usual water conditions. There must be freedom from or at least minimal attack on the parts by strong soaps and detergents.



1. Aluminum die castings for inaccessible parts that can't be reached for servicing.

2. Long die castings with thin section are difficult to produce.

Thus subject to the most severe abuse of any household appliance, a washing machine must continue to function year after year. To do this job the Thor Corp. depends on several die castings in critical places.

The pump housing and impeller shown in Figure 1 and all drain fittings (not illustrated) are examples of the use of die castings in critical spots. There is absolutely no opportunity for preventative maintenance on these parts, yet any corrosion by water or cleaning materials (or a combination of them) must be successfully withstood. Thus far, aluminum die castings are the best answer that the industry has found among materials that will allow economical manufacture.

In the washer's spinner basket itself, are three ring segments that prevent materials being spun dry from covering the water discharge holes, Figure 2. Here again corrosive action is bad and the rings must be of a material that can take it. Aluminum die castings are again the answer.

While the ability to resist corrosive action is the reason for using aluminum it is not the reason for die castings. Here, manufacturing economy enters. On the pump impeller the only machining needed is to size the hole for the impeller shaft. The housing has its mating flanges machined, the hole machined for bearings, pressed in, and the bolt holes drilled and where necessary tapped. No other

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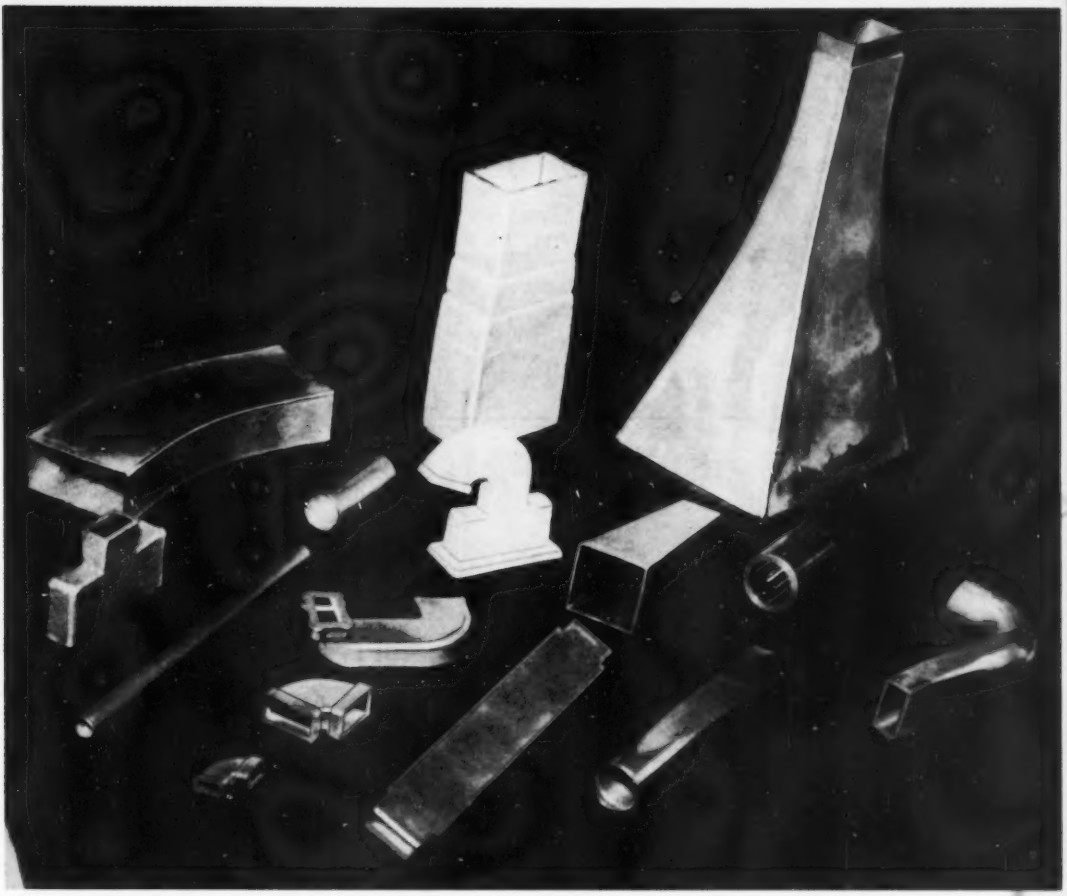

WHAT ELECTROFORMING OFFERS the designer of precision parts

A. G. BUSCHOW
Chief Engineer
Bart Laboratories Co., Inc.

ELECTROFORMING is an old process that grew in prominence during and after World War II. Unfortunately few engineers and designers recognize the possibility of manufacturing products by electroforming.

What is electroforming—Basically electroforming is the manufacturing of an article by the electrodeposition of metal on an object of predetermined shape, size, accuracy and finish, called a mandrel or matrix. These factors determine the inside dimensions and finish of the electroform. The electrodeposited metal is "built-up" to the required thickness and the mandrel or matrix is then removed.

When to use electroforms—Electroforming can be used to manufacture articles that cannot be made by conventional methods, especially those having thin wall sections, intricate internal shapes and high precision requirements as to dimension and finish of internal surfaces.

Electroforming can produce parts of intricate design, accurate dimensions and high interior surface finish. Combinations of metals may be used such as silver, copper, nickel and iron for specific applications such as conductivity, strength and corrosion resistance. Dimensional stability is easily obtainable whereas it would be impossible to hold dimensions by

other methods. Finishes on the order of 5 micro-inch can be attained.

In many cases it is less expensive than conventional methods and in some instances it may be the only practical means by which a part can be manufactured within the required tolerances, finish and metal specifications.

Metals used in electroforming—The metals usually used are copper, nickel and iron. These may be used singly or in combination. Other metals that can be incorporated in the electroform are silver, gold, rhodium and chromium. The use of these metals offer a wide selection to meet specific problems of conductivity, corrosion-resistance, strength and wear.

In general, the internal stresses of an electroformed article are low compared to many cast or forged articles. The physical properties of electrodeposited metals are equal to and in some instances exceed those of the same metals in cast or rolled conditions.

It is advisable to work out design details of part to be electroformed with the engineering department of the vendor since it is often possible to alter the design to aid the electroforming process without intefering with the function of the part.

Mandrels and matrices—This is the part that determines the shape, dimensional accuracy and the internal surface finish of the electroform and also affects its cost.

There are two types of mandrels or matrices used in electroforming, namely permanent and expendable. Permanent mandrels or matrices can be used only for pieces whose shape or geometry permits withdrawal of mandrel or matrix when the piece is completed. Expendable mandrels or matrices are used for pieces whose shape will not permit withdrawal of the mandrel or maxtrix intact.

Permanent mandrels or matrices are made of stainless steel, monel, brass and invar depending upon the shape of the electroform and the surface finish required. Permanent mandrels or matrices are applicable for close tolerance work on the order of ± .0002 and where high inside surface finish of 5 micro-inch is required.

Expendable mandrels or matrices can be broken down into several categories: (1) dissolvable metals (2) fusible metals (3) miscellaneous. Dissolvable mental mandrels or matrices can be made of pure aluminum or zinc. Fusible metals used are low melting point alloys of lead, tin and bismuth. Miscellaneous materials are sometimes used such as plastics, waxes and plaster of Paris.

External machining of electroforms—In some instances machining is not required but in cases where it is necessary machining is accomplished by conventional methods. However, considerable thought must be given to machining operations when designing mandrels since some intricately shap-

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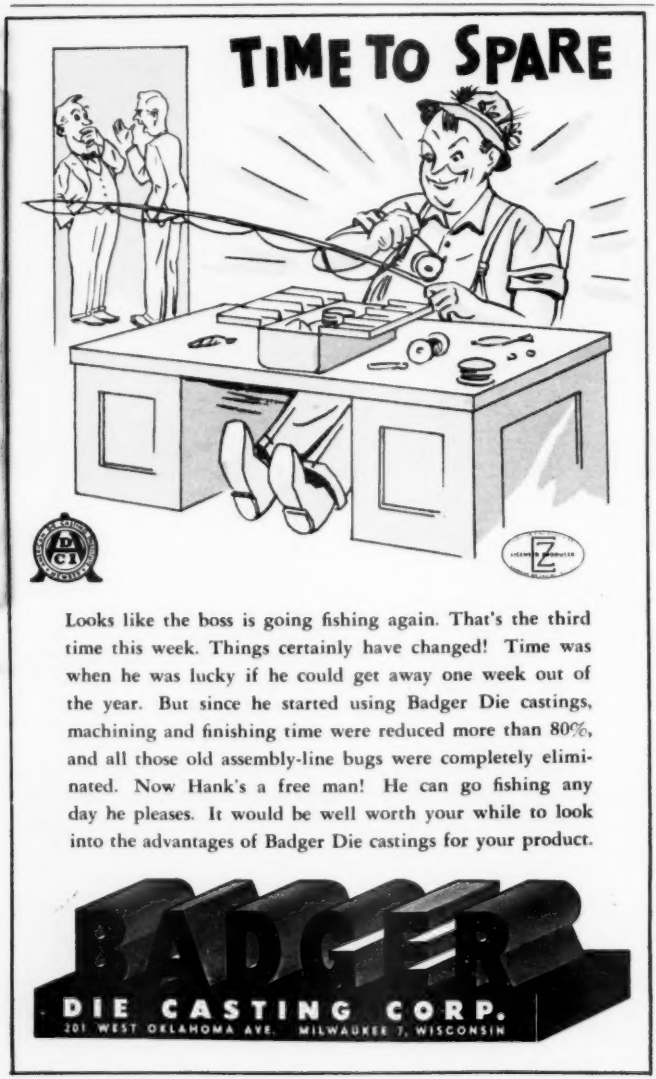
TIME TO SPARE
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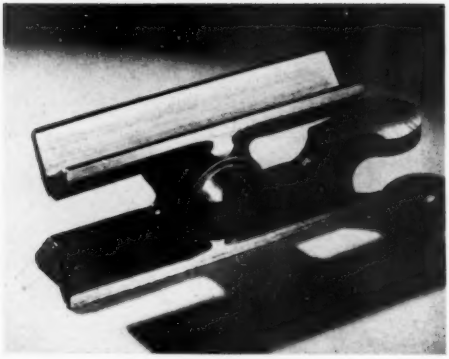


THE RAPIDLY MOVING CROSSHEAD for the cloth cutter, **left**, shown with front cover removed, needs a combination of strength and lightness that can best be attained by investment casting, **above**.

HIGH-SPEED, HIGH-STRENGTH PART
is produced by INVESTMENT CASTING

By LOUIS C. BLESCH
Chief Engineer
Wolf Machine Company

THE CROSSHEAD of the cloth cutting machine manufactured by the Wolf Machine Company of Cincinnati, Ohio, is a rather exceptional part in several respects. It is highly stressed, operates at high speed, must be maintained in precise alignment, must be highly resistant to wear and should be light weight.

These factors combine to fix the design rather rigidly. The high stresses combined with wear resistance and light weight dictate a fine grained highly alloyed part that is heat treatable to give the hardness required. Precision of alignment dictates a material that does not age or suffer dimensional changes with time (other, of course, than those changes brought about by wear). High speed operation and light weight requirements preclude the use of "beefed-up" sections.

Four methods of fabricating the part are possible.

Sand casting

If the part were to be sand cast, even though an adequately alloyed material were used, the normally large grain size resulting from sand casting would require heavy sections to give the strength required. The amount of machining that would be required would be excessive and rejects due to porosity and lack of balance would probably be high. These factors combine to indicate a part that would be heavy and costly.

Forging

Through the use of forging, a part of adequate strength with the desired microcharacteristics could be fabricated. The design would have to be changed, however, with resultant increase in weight. A major amount of machining would be required and the cost of the finished forging would be high.

Machining

Under machining can properly be considered both machining from bar stock or a forged blank as well as assembly by welding or brazing of machined components. Starting with bar stock, the machining job would be excessive. Waste of stock would be high and the cost prohibitive. Adequate rigidity would be questionable also. Finish machining of a forged blank, as contrasted with machining a nearly finished forging,

would also be wasteful and expensive. Assembly of machined components is possible, but the cost would again be high.

Investment casting

By investment casting the crosshead, an alloy of desirable physical strength can be used. Due to the inherent fine grain structure in the as-cast condition, the section thickness need not be any greater than either a forging or machined part would be. Where a sand casting or forging would, at best, be held to dimensional tolerances of ± 0.030 per inch, the investment casting can easily be held to ± 0.005. Section rigidity is more than adequate for the part. The crosshead as cast by Michigan Steel Casting Co. in their MC-6 alloy has all of these advantages.

It is on the final machining of the casting, however, that the investment process is of the greatest interest. In order to function safely and properly, the blade of the cloth cutter must operate exactly at right angles to the table and must have no side play in either the direction of cutting or across the direction of cutting. Further, the tip of the blade must enter the base guide smoothly and easily to prevent buckling and possibly breaking of the blade.

To secure this precision of operation, the crosshead is made with "vee" ways that slide on matching gibs. Adjustment of the gibs is, of course, possible, but the "vee" ways of the crosshead must be accurately machined so that they are parallel to each other. Parallelism is maintained on the ways to a maximum deviation of less than 0.001 in the total length of two inches.

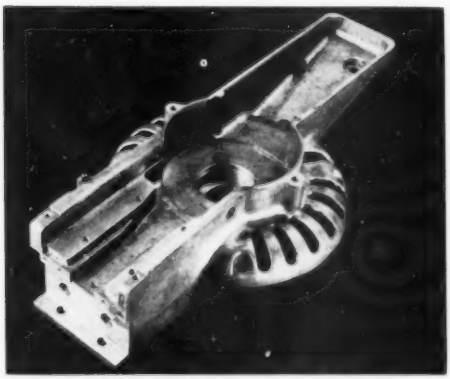
The tang onto which the cutter knife is fastened also requires a high degree of accuracy in its machining. Even though the ways are properly machined if the tang is not parallel to them, the blade will run out and thus cut the cloth pile at something other than ninety degrees to the table.

Through the use of an investment casting for the crosshead, all of these machining operations are minimized so that both machine time and labor are drastically cut. With only three relatively simple machining operations as compared with several times that many on a sand casting, forging or fully machined part, the machine time and man hours saved become highly significant.

The wrist pin hole is cast almost to size so that a reaming operation is all that is required before a bushing is pressed in.

The dollar saving achieved through the use of an investment casting for this crosshead is approximately 40 percent as compared with a machined sand casting. The less tangible, but even more important saving resulting from freeing men and machines cannot be determined directly. It is known, however, that several expensive machine tools which would have needed to be purchased are not now required. Duplication of some tools has also been avoided since the machine time the crosshead would have taken is now available for other uses.

Precision in a shell: mounting of working parts depends upon the DIE CAST housing



3. Dimensional stability is essential in this die cast housing.

From the point of view of "precision", one of the most interesting structural parts is the aluminum die casting that serves as a mounting case for all of the moving parts of the cloth cutting machine. This casting is shown in Figure 3.

The bore for one of the motor bearings is first machined and, using this bore as an index, the casting is fastened in a jig and all other machining operations done with the casting in the jig. The surface indicated by arrow, Figure 1, is the one critical surface of the entire casting. This surface must be machined flat and at right angles to the shaft of the motor. All other machining is then indexed from this surface.

When the machine is assembled, one of the "vee" gibs is fastened tightly against the die cast and machined surface while the other gib is adjustable so that minor wear can be taken up as it occurs. This die cast and machined surface must, therefore, be completely stable during the entire life of the machine.

In this cloth cutter, therefore, two PMM castings contribute to the successful operation: the investment cast crosshead and the aluminum die cast body.

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MR. A. NEUMANN,
Assistant Superintendent of Maintenance, Superior Plastics division of Commonwealth Plastics, Inc.

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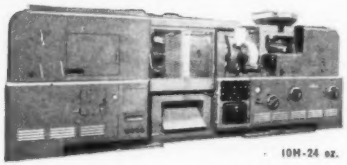
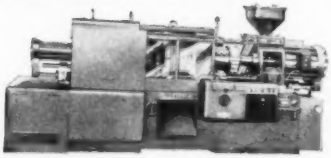
Superior Plastics, Division of Commonwealth Plastics, Inc., using many injection molding presses in 8 oz., 16 oz., 22 oz., and 24 oz. sizes, has installed Marvel Synclinal sump type filters in their machines. All of these machines are hydraulic. Mr. Neumann summarizes the amazing results: "Since installing Marvel filters we are able to operate our machines for four to six months before cleaning filtering units as against only two months with the former filtering equipment. This gives us two to three times as much production between cleanings. Furthermore, cleaning the Marvel is so simple and easy that we disassemble, clean, and reassemble it in minutes, a difficult procedure with the previously used filters".



10M-24 oz.



10D-8 oz.

Illustrated are two of the many Reed-Prentice injection molding machines used at Superior Plastics, division of Commonwealth Plastics, Inc.

Photos courtesy Reed-Prentice, Inc.

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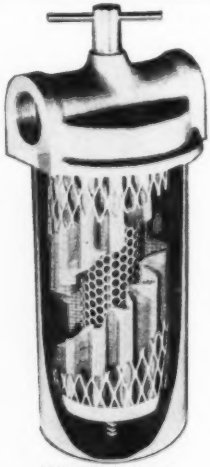

LINE TYPE (cutaway)

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FINISHING SECTION

MACHINING—Most precision metal molded parts require some machining operations. In this section will be found information to aid in planning and selecting the proper methods and equipment for these operations.

ASSEMBLING—Precision metal molded parts are generally components of assemblies. This section includes information on fastenings and methods for mass production assembly operations.

SURFACE FINISHING—Many precision metal molded parts receive some type of surface finish such as plating, organic coating, anodic coating or chemical coating. This section includes information on the methods, processes and equipment used for these surface treatments.

A Section Devoted To the Finishing Of

Die Castings
Investment Castings
Powder Metal Parts
Permanent Mold Castings
Plaster Mold Castings

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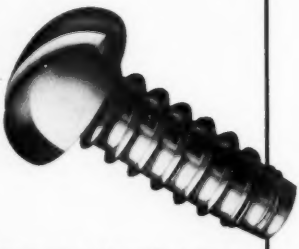

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METHOD OF MACHINING CARBIDE DIE for odd-shaped powder part illustrates new way of cutting hard materials

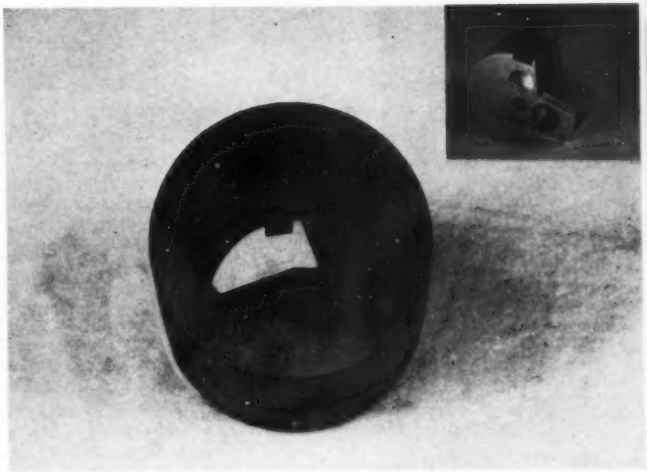
By JOHN S. ROLLER
General Manager
The Method X Co.

A SMALL brass rotor produced for Army Ordnance by powder metallurgy was the subject of an article in the February issue of PMM; this is the first large volume use of a powdered brass component by Ordnance.*

The rotor has an irregular contour which complicates the job of sinking a pressing die, especially when the die material is to be sintered carbide. For the quantities needed, these powder parts can most efficiently be produced in carbide dies which have longer life and greater resistance to the abrasive effect of the powder.

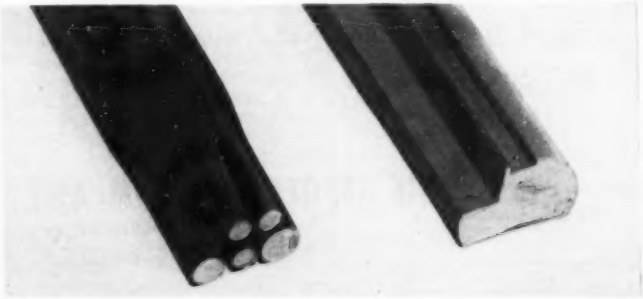
However, to cut an irregular contour in an exceptionally hard material such as sintered carbide is a formidable job for the die maker using any of the conventional machining techniques. On the other hand, if the machining is done on the partially sintered carbide which is subsequently to be fully sintered, problems of shrinkage complicate the task of holding dimensions. Sometimes this shrinkage ranges as high as 10 or 15 percent and is not uniform in all directions.

These are rather common problems in producing carbide dies for powder metallurgy because many



1. CONVENTIONAL MACHINING METHODS for cutting an irregular hole in a sintered carbide die blank would be very slow and expensive. The die shown **above** is used to form the brass rotor for Army Ordnance. **inset.**

2. ROUGHING CUT AND FINISH CUT in the carbide die are performed by the two brass electrodes, **below.** One at the left is built of turned bar stock, and removes the main part of the cavity, after which the brass extrusion, **right,** cuts the hole to size.



*"Powder Metallurgy Produces a Brass Ordnance Component: the full case history of an important piece," by Capt. John Dale, PMM Feb. '52, p 34.

parts having irregular contour are pressed in sufficient quantities to require carbide dies. For this reason, the method of machining carbide dies practiced by at least one fabricator of the powder brass rotors should be of interest to others working in the field of powder metallurgy; the machine and technique described here should have extensive application for the production of carbide dies.

Electromechanical system of metal removal

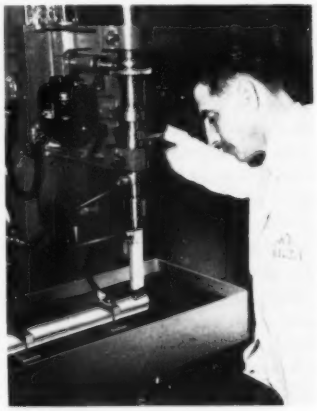
When air hardened steels are used for powder metallurgy dies, the conventional machining methods are satisfactory, although even here, non-symmetrical or non-round die openings may cause difficulty. When a carbide die having a contour such as that illustrated in Figure 1 is to be produced, there are certain specific advantages to be obtained by using the new method of metal removal developed and introduced under the trade name of Method X*.

This process operates on an electromechanical principle whereby electricity applied through specially shaped electrodes at high current densities result in the physical separation of metal particles from the work piece. As the electrode is slowly and steadily advanced into the work, the metal particles are flushed away by a dielectric bath in which the work is submerged. A cavity following closely the male shape of the electrode is thus produced (or, where desired, an external shape can be formed.)

The separation of metal particles is distinctly a mechanical, rather than a thermal effect of electricity, and has no effect upon the physical or chemical properties of the work piece. Surfaces on the order of 26 micro inches rms can be obtained, sometimes leaving less than .001 of stock to be removed by lapping to produce the desired finish down to 0.15 micro inches on sintered carbide.

Brass electrodes are easily machined at low cost

The electrodes employed here must of necessity be highly conductive and easily machined to the desired contour—two characteristics obtainable by using brass bar stock. The bar is machined to a negative of the shape to be produced.



3. ABOUT THE SIZE OF A DRILL PRESS, this Method X machine is capable of cutting holes in carbides or other super-hard materials. In actual operation, the work is submerged in a bath of dielectric liquid.

Two electrodes were required for cutting the die for the brass rotor, one for hogging out the rough hole

*Method X is a process developed by The Method X Co. of Pittsburgh, an affiliate of the Firth Sterling Steel & Carbide Co.

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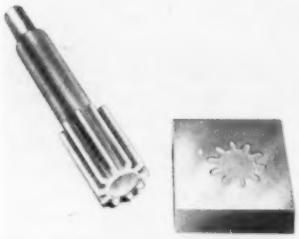
and the other for finishing. The electrodes are shown in Figure 2. The roughing electrode shown at the left was formed from five pieces of brass



4. DIES FOR GEARS to be produced by powder metallurgy are readily formed by using an electrode such as this one.

bar stock, ends of which were turned to the proper diameter and then assembled together. Since the rotors were, at one time, produced from extruded bar stock, a piece of this brass extrusion was employed as the finishing electrode, although machining of the bar shown at the right in Figure 2 would not have been difficult.

In some cases, the same electrode can be used for both rough and finishing cuts. Since the electrode is gradually consumed as it is advanced into the work, the eroded end is cut off after the roughing operation, and the same electrode is used for finishing after the necessary electrical adjustments have been made.

In the process of removing material from the work piece, the electrode does not come into direct contact with the work, but an adjustable gap of a few thousandths, dependent on the surface finish desired, remains constantly between the two surfaces. A dielectric fluid such as kerosene, fuel oil or a fluid specially developed for the Method X machine is used to submerge the entire cutting operation. Purpose of submerging the work is not only to flush away the loosened particles from the work area, but also to build up electrical resistance so that the energy storage devices in the machine may be fully charged prior to discharge.

Machine's construction similar to that of drill press

Design of the Method X machine, Figure 3, is similar to that of a drill

BARREL FINISHING NEWS

Tests prove Super Honite gives top cutting speed!

ST. PAUL, MINN.—Industrial research groups across the country recently completed a series of comparative tests on the cutting speeds and lasting qualities of all barrel finishing chips now on the market.

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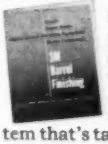

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press with pedestal type base, an electrode feed and control mechanism, and a remote unit power supply. The machine has a work table provided for longitudinal, lateral and vertical traverse and full rotation for work alignment.

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Gear shapes, threaded holes and surface detail

A category of powder metal part which has come into extensive application within the past few years is the small gear or ratchet. The use of powdered iron, copper or brass for small pinions, timing gears, racks and ratchets has grown rapidly because of the combination of low cost, high tooth strength and accurate tooth form which can be obtained. Sometimes, in addition, the self-lubricating properties of powdered metal are utilized.

Carbide dies are desirable for parts of this type, but the sinking of a gear form into a carbide die block is slow and expensive. Now, with a low cost, machined brass electrode such as the one shown in Figure 4, gear and ratchet shapes are as readily worked into carbide as are the simpler shapes.

Where a die piece needs to be mounted by means of screws, it is possible to bore a hole by this method for gas turbine blades with a Method and then generate a screw thread by steadily rotating the work piece beneath the electrode, synchronized accurately with the downward motion of the electrode.

The new process also suggests the possibility of machining holes or external shapes in carbides and other hard materials on a production basis. Some work has already been done in cutting the root mounting serrations for gas turbine blades with a method X machine.

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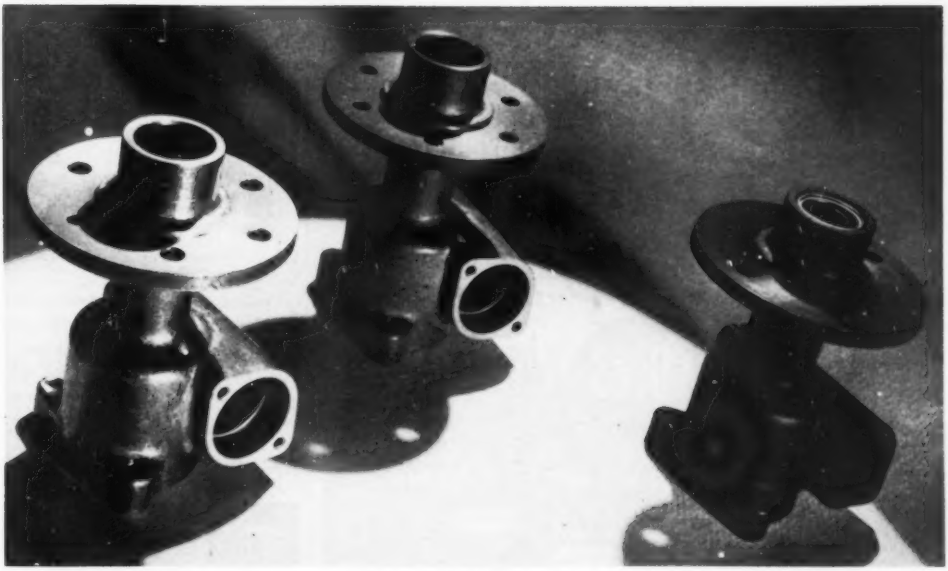

Raw casting . . . anodized . . . and dyed

BLACK ANODIZING of aluminum die castings is a production operation

By K. W. McCREA
General Manager
Acme Plating Co.

WHEN aluminum die cast parts are to be exposed to severe corrosive atmospheres, it is customary to protect the exposed surfaces. One important method is the electrolytic oxidation of the surface, which not only provides corrosion protection, but offers an excellent base for dye or paint.

This process, known as anodizing, has a number of process variations, depending upon the alloy of aluminum and the fabricated form, whether cast, wrought, sheet, etc. The Acme Plating Company of Cleveland, Ohio, employs the Alumilite process to anodize aluminum parts on a production basis, including many die castings.

The basic steps of the Alumilite process, as practiced at Acme with a sulfuric acid electrolyte, are:

1. Clean the casting in any suitable alkali cleaner.
2. Rinse in cold water.
3. Anodize in 15 percent sulfuric acid for 30 minutes at a current density of 15 amps. per sq. ft. and a temperature of 75±2F.
4. Rinse in cold water.
5. Neutralize in 5 percent sodium bicarbonate solution.
6. Rinse in cold water.
7. Dye.
8. Rinse in cold water.
9. Seal dyed coating in 5 percent solution of potassium bichromate solution. Maintain solution at —212F and a pH of 5 to 6.
10. Rinse in cold, then hot water.

Of the various steps listed above, most are self-explanatory. The actual anodizing step is, of course, the formation of a thin, adherent film of aluminum oxide on the metal surface. The film is relatively hard and from 0.0002 to 0.0003 thick.

The acid concentration of the anodizing solution is carefully controlled and held as near as possible to 15 percent free acid. When the aluminum sulfate content of the bath reaches 1-¼ oz. per gallon, the bath is discarded.

Any of a variety of dyes are suitable for coloring the anodized surface.

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helps 6 people do the work of 16

The Whirlpool Corporation found a real solution to manpower scarcities and rising prices when they installed Roto-Finish Deburring Machines. By this mechanical method, 6 people now deburr an even greater quantity of parts than 16 could do before. Thus a much needed source of manpower was found for use in other operations.

The cost of deburring individual parts has been reduced 50% to 90% as shown above. And in addition, parts can now be deburred economically that were impossible to do by hand methods because the cost was prohibitive. Roto-Finishing these parts in some cases has eliminated special handling in subsequent operations. As a result, production has been speeded and manhours have been saved in stamping, grinding and other finishing operations.

Let us show you how you can make similar savings in time, manhours and money. Send sample parts to the Roto-Finish laboratory for a free demonstration. Write for full details today.

Roto-Finish COMPANY
associated with The Sturgis Products Co.
3716 MILHAM ROAD, KALAMAZOO, MICH.
P.O. Box 988 — Phone 3-5578

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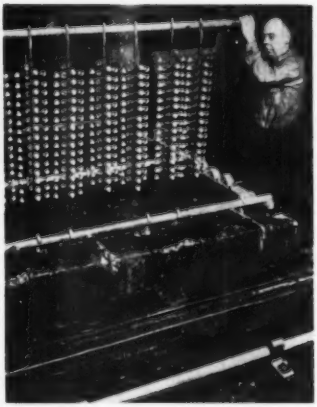
ORIGINATORS OF THE ROTO-FINISH PROCESSES
For additional information circle No. 77 on the Reader Service Card

In the parts illustrated, a black dye has been used—in this case, Sandoz aluminum black made by the Sandoz Chemical Company of New York. The dye bath contains 5 grams of dry powder per liter and is operated at 150 to 160F.

The sealing operation stabilizes the dye and prevents it from bleeding out, also and increases the corrosion resistance. The action is believed to be the formation of an aluminum monohydrate film on the surface.

Sealing can also be accomplished in hot water, but the resistance to corrosion is not as great as when the potassium bichromate is used.

As an indication of the corrosion resistance imparted by this treatment, the untreated aluminum die castings exposed to a standard salt spray test



LARGE VOLUME OF PARTS can be processed simultaneously on racks. Close process control is exercised in black anodizing.

stand up a maximum of 24 hours; after anodizing, they withstand the same salt spray for a minimum of 250 hours (Fed. Spec. AN-QQ-A696a).

An alternative anodizing process that is used in many cases has chromic acid as the electrolyte. In this process, the bath is started at about 5 percent chromic acid content and acid additions are made to maintain the pH under 1. When the acid additions become uneconomical, the bath is dumped and a new one started.

The chromic acid method of anodizing gives a harder, thinner oxide film on aluminum than does the sulfuric acid. Generally, the film is less than

0.00005 thick and cannot be effectively dyed.

Composition of the alloy used in making the die casting will determine, to some extent, which anodizing process is used. The major alloying element that controls the process is copper. When the copper content of the alloy is over 5 percent, the sulfuric acid process must be used.

On the other hand, the corrosive action of the chromic acid bath is somewhat less than the sulfuric acid bath so that where there are holes or recesses in which electrolyte might be trapped, the chromic acid bath is preferred. Current requirements for the two processes are different and, generally, the sulfuric acid bath is easier to control.

One aspect of the commercial anodizing of aluminum that is not generally appreciated is that when work for the armed forces is involved, the anodizer must be certified by the armed services. This certification requires that the company doing the work submit anodized samples for government test and inspection. Once approved, the plant must be recertified every six months and is subject to periodic unannounced checks and inspections.

SIMPLE ALUMINUM COLORING TECHNIQUE

is suitable for common die cast alloys

THE COLORING and protection of aluminum by means of a new process introduced by Enthone, Inc., permits the use of such colors as yellow, blue, green and brass on cast or wrought alloys.

The new process, called Alumox 44, is reported to be successful on almost all aluminum alloys including the common die cast alloys containing silicon. The latter has a tendency to darken the coating so that the same color value cannot be obtained as are formed on the wrought alloys, but where a somewhat darker color is acceptable, the results are entirely satisfactory.

Alloys containing more than two percent magnesium, it has been stated, have proved to be difficult to color.

The procedure developed by the manufacturer consists of cleaning the aluminum parts and then immersing them in a proprietary solution of Alumox 44 salts. Dyes can be added to the processing solution so that coating and dying occur simultaneously, or they can be carried out separately.

Alumox salts are available as a powdered material which is added to water in a concentration of 1 lb. per gallon. The bath operates in the temperature range of 190 to 210F, and coloring is accomplished in from 15 seconds to 2 minutes. Although the dyes are not sold by Enthone, a recommended list of dyes has been prepared.

Objects that have been successfully colored include aluminum hardware, jewelry, slide fasteners, automobile trim, nameplates, electrical fittings, lamps, pencil parts and medallions. Some of these are included in the accompanying illustration.

The use of gold or brass coloring on aluminum, it is believed, will permit the substitution of aluminum in some places where copper-gase alloys have previously been used. Another use of the Alumox 44 bath is the provision of a clear coating on aluminum to reduce finger marking and to increase weather resistance. The coatings are relatively non-conductive and have a thickness of approximately 0.0001.

PMM NEW PRODUCTS

For additional information on the products appearing on this and the following pages, mark the key number of the item on the card bound into this issue. Drop the card in the mail — no postage is required.

POWDER METALLURGY PRESSES

Model 20 & Model 45

Baldwin-Lima-Hamilton Corp.

SPECIFICATIONS:

	Model 20	Model 45
Rated Pressure	75 tons	200 tons
Maximum Resistance of Floating Die Holder	15 tons	30 tons
Height to Top of Die	51¾ in.	74⅜ in.
Overall Height	102¾ in.	151⅜ in.
Floor Space	41" x 65"	66" x 91"
Weight	7200 lbs.	19,500 lbs.
Strokes per Minute	30 - 60	30 - 60
Motor for Variable Speed Drive	5 HP	15 HP
Maximum Movement of Die Holder	1"	2⅜"
*Maximum Die Space — Rectangular	4" x 7"	5" x 10"
*Maximum Die Space — Round	4" dia.	8½" dia.
Die Block Thickness	2-7/15"	4"
Maximum Depth of Fill	2¼"	3⅞"
Stroke of Head	4"	7¾"
Clutch	Multiple disc treadle operated	Air clutch and solenoid with start, stop, and jog buttons.

* Either optional at no extra cost. Only one type can be used.

SPECIAL FEATURES: Mechanically-operated presses specifically designed for powder metallurgy work. Four column, single action units, equipped with floating die tables to give the effect of double action. Both presses have variable speed drives connected to a fly wheel with "vee" belts. The fly wheel connects with a pinion shaft through a multiple disc clutch. Linkage from the pinion shaft to the cross head carrying the punch is through a bull wheel on a crank shaft which in turn activates the cross head through connecting rods.

The ejection mechanism is activated by cams mounted on each side of the bull wheel. The cams, through ejection rods, are connected to the ejection base plate which carries the lower ram. Depth of fill is easily controlled by a hand wheel mounted on the front of the machine. The density of the part being pressed, that is the movement of the upper punch inside the die, is controlled by another hand wheel mounted on top of the head. Both controls are graduated to indicate accurately the respective movements.

The die is filled by an air operated feeder slide which also serves to push completed parts away from the die. By means of a four way valve the feeder mechanism can be held in its rearmost position. Timing of the feeder movement is from a cam on the main crank shaft.

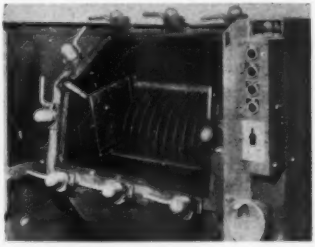
The floating die holder is connected to a hydraulic cylinder by means of tie rods. No controlled or forced floating die action is provided. The point at which pressure in the hydraulic cylinder starts to build up and the amount of pressure build up are both controllable up to the maximum pressure provided for each press. This type of control eliminates the "weld line" at changes of section in the part being pressed. Since the hydraulic cylinder is part of a closed system no pump is needed other than a hand pump to fill the system with oil.

For additional information circle No. 144 on the Reader Service Card.

BARREL FINISHER FOR DISC-TYPE PARTS

DW 30-36-1SF

Roto-Finish Company



SPECIAL FEATURES: Designed especially for finishing disc type circular parts at low cost. Machine is of the stationary fixture type, using directional flow of finishing media for uniform results.

SPECIFICATIONS: Single 30⅛" x 35¼" ID rubber-lined compartment with 18 cu. ft. capacity. Large door opening facilitates handling large parts. Patented quick action spring-loaded pressure releases prevent excessive pressure build-up. Push button

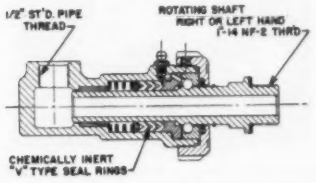
control, plus automatic timer which is available for controlling operation up to 20 hours without attention by an operator, make this a low cost, semi-automatic machine. Speed can be varied from 10 to 30 rpm.

Side supports, motor mount and floor of the machine are integral parts of a rigid frame eliminating need for bolt-down. Lower part of housing is fully enclosed to prevent chips or water lodging behind the framework. Shafts of the rotating cylinder are mounted on 2⅞" self-aligning ball bearing pillow blocks.

For additional information circle No. 145 on the Reader Service Card.

REVOLVING JOINT FOR HYDRAULIC OR AIR

Barco Manufacturing Co.



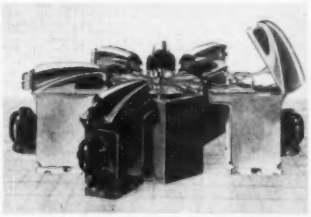
SPECIAL FEATURES: Light-running, revolving joint for making air or hydraulic line connections to high speed rotating chucks, clutches or similar equipment features new type chemically inert "V" seal rings with low friction coefficient.

SPECIFICATIONS: Connection to rotating machine is made by screwing the male threaded steel shaft of the joint into the hub of the clutch or chuck. Available with right or left hand 1" -14 NF-2 straight machine threads for the rotating connection. Connection to the stationary end of the joint may be by standard ½" pipe or flexible hose. Overall length of the joint is 6-9/16" with wide spacing between bearings. Stands temperatures to 425F and speeds to 1800 rpm or more under certain conditions.

For additional information circle No. 146 on the Reader Service Card.

POLISHING MACHINE FOR JET BLADES

Micro-Lap Machine
Murray-Way Corp.



SPECIAL FEATURES: Production of 5-10 rms finish longitudinally with 6 heads at rate of 720 pieces per hour at 100% efficiency. Once machine is set from and to a standard, every piece is reported to be identical. Stock removal varies with grit sequence (.001 to .0015 per side was removed to produce above finish).

SPECIFICATIONS: Standard machine takes any blade up to 9" length. Table fixtures adjustable to 2½". Two abrasive cloth strips are used per head, one for each side of the blade. Abrasive cloth available in 50 yard rolls. Operator loads and unloads during dwell time between indexes, adjustable from 2 sec. to 3 min. by 0.3 sec increments. Dial table with 8 fixtures is 44" in diameter around which are 6 polishing heads. Floor area requirements are 7½' x 10'. Table indexing is hydraulically controlled. Motors operating the heads are 3 hp, 1200 rpm, 3 ph, 60 cy TEFCBB while the motor for the hydraulic circuit is 3 hp, 1750 rpm, 3 ph, 60 cy TEFCBB.

For additional information circle No. 147 on the Reader Service Card.

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These famous long-wearing buffs run cool under all buffing conditions. Constructed of high count bias-cut cloth mounted on safe steel centers. Available in a wide range of densities and center diameters.

for

STYLE C-20 CONTACT WHEELS and F-26 Belt Lubricant

A C-20 flexible Contact Wheel will form itself to the shape of the work and permit the abrasive belt to polish contoured surfaces and F-26 Abrasive Belt Lubricant will increase belt life by preventing loading and glazing. Produces finer, smoother and brighter surfaces through lubrication.

for

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A complete line of production buffing compounds. Produced in bar and tube form. Formax is the originator of the "Spraymax" Liquid Compounds for brush or spray application.

for

FLEX-A-GLU POLISHING WHEEL CEMENT

—A flexible synthetic adhesive in a ready-to-use form. Dries quickly. Increases polishing wheel life and produces uniform finishes regardless of grit size used.

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MANUFACTURED IN CANADA BY JOHN GALLOWAY LTD., KITCHENER, ONT.

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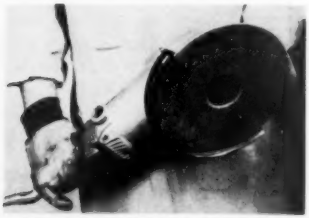
REINFORCED FLEXIBLE GRINDING WHEEL

Norton BFR Wheel
Norton Co.



SPECIAL FEATURES: Lightweight flexible hub-type grinding wheel used with "right angle" or "sander" type portable grinders, is said to rough grind, finish grind and notch — all with the same wheel. Used to blend contours, smooth down welds and notch risers on castings.

SPECIFICATIONS: Wheel is made of carded web material impregnated with abrasive grain. Sufficiently flexible to permit blending contours. The BFR wheel fills a gap between the stiffer BD type wheel and the coated abrasive discs manufactured by Behr-Manning Corp., a Norton subsidiary.

For additional information circle No. 148 on the Reader Service Card.

VACUUM IMPREGNATION OF CASTINGS

F. J. Stokes Machine Co.

SPECIAL FEATURES: Vacuum impregnation with sodium silicate or other heat resistant materials to make metal castings pressure-proof. Particularly suitable for light metals, brass, bronze, etc. Main use is for capillary porosity defects rather than visible porosities which permit spurting under hydraulic pressure.

SPECIFICATIONS: Castings to be impregnated are placed in a vacuum chamber. Air is removed by high-vacuum pump. Impregnating compound is introduced into the chamber and fills all capillary voids. Jet engine compressor housings and magnesium-aluminum alloy gear boxes are currently being vacuum impregnated by this process.

For additional information circle No. 149 on the Reader Service Card.

NYLON HOLDER FOR FELT MOLD POLISHING WHEEL

Detroit Mold Engineering Co.

SPECIAL FEATURES: Danger of damaging the work surface with conventional "center-screw" type of felt holder is eliminated. Slippage and eccentricity of felts which are major causes of felt breakage, are reported to be completely eliminated. Longer life for felts results because they can be re-dressed right down through the axis without running into a center shaft.

SPECIFICATIONS: The holder is molded of nylon around a 1/8" diameter steel mandrel insert. Socket-type design utilizes centrifugal force of the felt in conjunction with raised beads along inside of the holder to give a solid gripping action on the felt bob. Produced in 3 standard sizes: 1/4", 1/2" and 3/4" diameters.

For additional information circle No. 150 on the Reader Service Card.

THE **OLS** FOR BETTER PLATING

Before you invest in barrel plating equipment, check the features of the Daniels OLS Plating Barrels. Forty years of experience in manufacturing barrel plating equipment have led to the new Daniels OLS which can only be fully appreciated by thoroughly reviewing the facts as illustrated in our new catalog.
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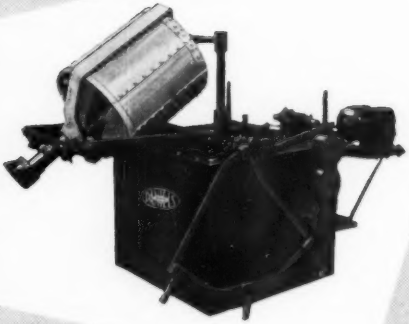

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PMM USEFUL LITERATURE

PROCESSES

A Review of the Plaster Mold Casting Process: No. 9
In a new booklet from Atlantic Casting and Engineering Corp., the Atlantaloy process for producing non-ferrous castings from plaster molds is thoroughly reviewed. All phases of the subject are covered, including the method of production, the alloys available, typical parts, physical specifications and the company's facilities.

Die Castings—1000 Pieces Per Pound: No. 15
A bulletin from Dollin Corp. describes the company's facilities for commercial production of die castings, including their Small Castings Department which specializes in zinc die castings ranging from 3 to 1000 pieces per pound.

Four Ways to Cut Production Costs: No. 59
A leaflet on the theme, "Every Yoder die casting cuts someone's costs," shows four ways in which die castings can be utilized to save money on assembly, materials, inventory and machining time. The leaflet issued by Yoder Die Casting, Inc., also illustrates company facilities.

Aluminum & Zinc Die Castings: No. 145
Photos of some die castings in zinc and aluminum, several plant photos, and tabulations of alloy compositions and properties are contained in a 4-page folder from Tool-Die Engineering Co., Inc., of Cleveland.

Six Case Histories of Zinc Die Castings: No. 146
In the current issue of The Alloy Pot published quarterly by the New Jersey Zinc Co., six case histories illustrating the application of zinc die castings are presented. These include the design of a lamp, grease seal, hydraulic jack, fuel pump, bench saw and gasoline engine.

Manufacturing of Powdered Metal Parts: No. 147
Ten photos showing the various phases of producing powdered metal parts are contained in a folder from Michigan Powdered Metal Products Co., Inc., contract manufacturers of parts from metal powders. Also included is an insert showing the characteristics of seven different types of powdered metal parts and a summary of the effects of carburizing and heat treating.

Aluminum Bronze Die Castings: No. 148
In an 8-page illustrated booklet, the Aurora Metal Company gives complete background and design information on the aluminum bronze die castings which it produces.

Ferrous and Non-Ferrous Investment Castings: No. 149
Parts investment cast in brass, bronze, beryllium copper and steel are illustrated and described briefly in a 4-page folder from Gray-Syracuse, Inc.

Advantages & Limits of Powder Metallurgy: No. 150
Applications of powder metallurgy, together with a commentary on the advantages and limitations of production, are incorporated into a folder No. 567 from Plastic Metals Div., National Radiator Co.

Plaster Mold Casting Data for Engineers: No. 151
In a 12-page data book, Ohio Precision Casting Company offers information on plaster mold castings which will be helpful to product designers. Particular emphasis is given to castings in copper, brass, bronze and aluminum.

MATERIALS AND EQUIPMENT

Aluminum Alloy Avoids Heat Treating: No. 155
Full technical data on a new aluminum alloy called Almag 35 are available in a brochure from William F. Jobbins, Inc. The alloy is reported to eliminate the need for heat treating and to offer a range of high physical properties in the as cast condition.

Stainless Steel Data Book: No. 156
A book from Carpenter Steel Co. contains "Working Data" on Stainless No. 10 and other stainless and heat resisting steels.

Use of Instruments for Permanent Mold Quality Control: No. 157
A review of quality control at the Chicago permanent mold plant of Alumicast Corp. is featured in the January issue of Wheelco Comments published by Wheelco Instruments Co. Equipment used for melting and pouring, temperature control, alloy composition, physical testing and heat treatment are summarized.

Die Filing Tool: No. 158
A die filing tool that combines reciprocating, rotating and oscillating action is presented in a folder from Nord International Corp. Called the Di-Profiler, it files, hones, polishes, laps, chafes and saws materials ranging from carbide bits to wood or fiber.

Dew Point Recording: No. 159
Where moisture control is important in controlled atmosphere furnaces, such as those used for sintering, Foxboro Company offers a detailed bulletin and data sheet on dew point recording or recording-controlling systems.

Six-Step Impregnation of Castings: No. 160
Description of their six-step process for impregnating castings to overcome porosity is the subject of a folder from American Metaseal Corp. Also included is information on impregnating materials.

Several Types of Furnaces: No. 161
From Pereny Equipment Co., a brochure gives data on several types of industrial furnaces which the company manufactures, including units for sintering, melting, electric heat treating and labpratory research.

Instruments for Determining Oxygen Content: No. 162
A thorough report on the M.S.A. oxygen indicator for precise, continuous measurement of the oxygen content of gaseous mixtures is presented in a folder from Mine Safety Appliances Co. Designed for the metallurgical, chemical and petroleum industries, the new C-2 indicators give direct readings of oxygen concentrations within 2% of the selected scale range.

FINISHING

Grinding, Polishing & Buffing Catalog: No. 170
A 20-page booklet from Hammond Machinery Builders, Inc., covers their complete line of abrasive belt and wheel, grinding, polishing and buffing machinery. Specifications, illustrations and descriptions are included on bench and floor type wheel grinders, polishing lathes and backstands, as well as buffing and polishing accessories.

Integrated Line of Drilling & Tapping Tools: No. 171
A group of production drilling and tapping tools is presented in a 12-page catalog from Commander Mfg. Co. showing their multiple spindle drill attachments for use on single spindle presses, a tapping attachment which fits any drill press, a drill chip breaker, a multi-angle drill unit, and drilling work table with self-contained coolant system.

Principles of Abrasive Cutting: No. 172
An informative 36-page booklet, "Principles of Abrasive Cut-

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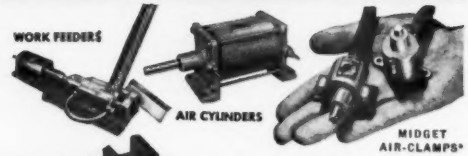

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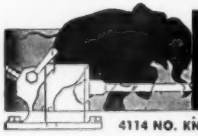

MEAD SPECIALTIES COMPANY

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For additional information circle No. 71 on the Reader Service Card

ting," has been announced by the Campbell Machine Div., American Chain & Cable Co., Inc. Basic principles of cutting, its methods and applications are fully described.

Power Screwdriver Bits: **No. 173**

A range of sizes and styles of bits designed specifically for use with power screwdrivers are shown in a folder from Ludwig Hommel & Co. The line includes ¼" hex drive and threaded shank drive bits for slotted, Phillips and Frearson screws.

Method of External or Internal Chucking: **No. 174**

Introduction of a new principle of external or internal chucking is the subject of literature from Scully-Jones & Co. whose "Roll-Lock" mandrels, arbors and chucks are said to have extremely rigid and accurate centering.

Soldering & Brazing Gun: **No. 175**

A production soldering and brazing gun built to deposit lead and tin base solders, silver solder and brazing wires in a liquid or semi-liquid form to any constant moving part is presented in a folder from Metallizing Co. of America.

Hydraulic Drilling Units: **No. 176**

In a 12-page catalog, Delta Power Tool Div., Rockwell Mfg. Co., features hydraulic drill units developed for drilling, reaming, tapping, chamfering, spot facing, centering and similar operations.

Directions for Rhodium Plating: **No. 177**

Directions for rhodium plating commercially are available from Baker & Co. inc. Rhodium is a hard, brilliant white, tarnish-proof precious metal useful for scientific, medical, and electronic types of applications.

Bright Zinc Plating Additive: **No. 178**

An additive for bright zinc plating sold under the trade name of Durobrite Addition Agent 309 is the subject of literature from E. I. du Pont de Nemours & Co., Inc. It is said to be suitable for use in any type of cyanide zinc plating, in all types of plating equipment.

Machine de-burring
with NOBUR
pays BIG production dividends!
NOBUR Tools turn a slow bench operation into fast and efficient machine work! Remove burrs on multi-walled parts with a smooth, clean cutting action that won't mar highly finished surfaces. Eliminate rejects from slow, costly hand work with files, scrapers and abrasives.
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Nobur Tools cut freely on either hard or soft metals, are simple in construction and are made in sizes to cover a full range of hole diameters. *NEW "DS" SERIES extends range of NOBUR applications to holes as small as 1/8" diameter. WRITE FOR FULL DETAILS TODAY!
Parts like these quickly de-burred with
NO/BUR TOOLS
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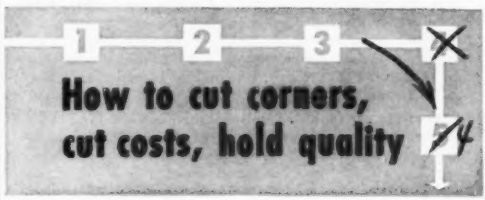

OAKITE metal-cleaning procedures can make an entire production operation easier, cheaper, quicker. Here are two examples:

1. Pre-Paint Treatment Saves $800 Monthly That's what an electrical manufacturer credits to the OAKITE Crys-Coat PROCESS, which simultaneously cleans and phosphates metal surfaces.

2. New Brass Cleaner Makes Big Savings A large electroplating job shop cleans brass with a new Oakite formula that minimizes tarnishing and rejects; cleans so well that, in many cases, a copper strike is dropped from the plating cycle.

FREE Write Oakite Products, Inc., 34G Thames St., New York 6, N. Y., for the new 44-page booklet *"Some good things to know about Metal Cleaning"*. Subjects:

Machine cleaning	**Tank cleaning**	**Electrocleaning**
Pre-paint treatment	**Pickling**	**Paint stripping**
Steam-gun cleaning	**Burnishing**	**Rust prevention**

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE SPECIALIZED INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

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turn these jobs into full speed, profitable production runs. It's all in the right combination of equipment, contact wheels, and fast-cutting, long-lasting BEHR-MANNING Abrasive Belts. BEHR-MANNING Engineers can put you on the right track with the combination that's right for your polishing job. They'll demonstrate the latest equipment in a conveniently located BEHR-MANNING Demonstration Room or in your own shop, if you prefer. Make a date now.

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"Blueprints for Faster, Better Production" contains case histories of new contour polishing operations and other "out-of-the-ordinary" abrasive finishing jobs. Write Behr-Manning Corporation, Troy, N. Y. for your free copy today. Address Dept. **PR-3**

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For Export: Norton Behr-Manning Overseas, Inc.

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REFERENCE MATERIAL, catalogs and data offered free in this month's ads (circle numbers on reader service card.)

DIE CASTING FACILITIES of the Admiral Die Casting Co. are described in an illustrated booklet available from the company.

DIE CASTING FOR defense is the subject of a booklet, "We're Geared for Your Defense Needs" from Advance Tool & Die Casting.

INFORMATION ON MELTING furnaces is available in a pamphlet from Ajax Engineering Co.

PLASTER-MOLD CASTINGS by Atlantic Casting & Engineering Co. are described in "Quality Precision Castings."

METAL-OF-THE-MONTH is a resume of market news, etc. issued by the Belmont Smelting & Refining Co.

DIE CASTING INJECTION speeds up to 400 fpm are reported in a catalog of die casting machines from Hydraulic Press Mfg. Co.

DESIGNING FOR POWDER metallurgy is the subject of an engineer's handbook from International Powder Metallurgy.

DIE CASTING MACHINES are the subject of a folder from the Kux Machine Co. showing small vertical and horizontal units with 1½ lb. capacity.

HOW TO DESIGN aluminum and magnesium die castings is the subject of a data book from Litemetal Dicast, Inc.

OIL LINE FILTERS for hydraulic and low pressure circuits are described in literature offered by Marvel Engineering.

SPECIFICATIONS for the Cast Master die casting machine are presented in a catalog from Miller-Taylor.

MELTING EQUIPMENT: a complete line of ladles, ingot molds, kettles, compounds, etc. are included in a catalog from C. H. Milles.

FACT FILE pertaining to aluminum permanent mold & die castings, and zinc die castings is offered by Monarch Aluminum.

FACILITIES of the New England Die Casting Co. are described and illustrated in a booklet.

DIMENSIONING DIE CASTINGS is an important engineering handbook for designers, compiled by Newton-New Haven Co.

ANALYSIS AND SPECS of aluminum, brass, & bronze alloys are given in a 36 pg. book from Sonken-Galamba.

HOW TO HEAT WAX for making investment casting patterns is the subject of a booklet from Sta-Warm Electric Co.

MELTING & HOLDING furnaces for magnesium and aluminum are covered in a bulletin from Stroman Furnace.

ALUMINUM ALLOY SELECTOR, a handy guide to the proper selection of alloys, is offered by U. S. Reduction.

"THERE'S A PLACE IN YOUR Production Line for Die Castings by Yoder", a booklet from Yoder Die Casting Co.

AUTOMATIC SHOT CONTROL for die casting zinc or aluminum is the subject of a technical bulletin from Ring Valve Co.

MATERIALS FOR INVESTMENT casting. Information folders are available from the Centrifugal Casting Supply Co.

HIGH SPEED ENAMEL FILLING machines are described in a booklet from Acromark.

BARREL FINISHING: process, equipment and materials are fully explained in literature from Almco Div., Queen Stove Works.

FASTER PRODUCTION through proper use of abrasive belts is well-illustrated in a book of case histories from Behr-Manning Co.

BUFFS, CONTACT WHEELS, cement and buffing compounds are described in folders available from Formax.

PNEUMATIC DEVICES, including air cylinders, work feeds and valves are covered in a complete catalog from Mead Specialties.

FAST-CUTTING CHIPS for barrel finishing are described in literature offered by Minnesota Mining & Mfg.

DEBURRING THE EASY WAY is described by Nobur in their literature on machine deburring.

BASIC INFORMATION pertaining to metal cleaning is contained in a pocket-size booklet from Oakite Co.

Continued on page 62

PROMOTIONS AND APPOINTMENTS

DR. WILLIAM HIRSHKIND, research director of *The Dow Chemical Co.*'s Western Division, to be technical adviser to Dow President Leland I. Doan.

JOHN H. GORMAN as an electrochemist on the technical staff of *Hanson-Van Winkle-Munning Co.*, Matawan, N. J.

ALAN H. HARRIS as products manager of the *Phosphate Coating Div., Detrex Corp.*, Detroit, Mich.

J. DUDLEY LOCKREM, vice president, as sales manager of *Scully-Jones and Co.*, Chicago.

THOMAS T. PHIPPS, as sales engineer in the Cleveland territory for *Surface Combustion Corp.*, Toledo, Ohio.

MARY ELLEN GREEN has joined the industrial design firm of *Sundberg-Ferar* as the only feminine member of its design staff.

CHARLES H. BARNETT as assistant to the president of *The Foundry Equipment Co.*, Cleveland, Ohio.

CARL C. CLABAUGH as technical representative in the Philadelphia-Eastern Pennsylvania area for *Cowles Chemical Co.*, Cleveland.

ANDREW B. STEVENS as assistant factory manager for *American Wheelabrator & Equipment Corp.*, Mishawaka, Ind.

LEON F. MILLER, vice president in charge of sales and engineering, to become a director of the *Osborn Manufacturing Co.*, Cleveland, Ohio.

ARTHUR E. STEHLE as Midwest district manager in the Chicago office of *Ettco Tool Co., Inc.*, of Brooklyn, N.Y.

DR. ABNER BRENNER as chief of the Electrodeposition Section of the *National Bureau of Standards.*

DR. GEORGE O. CURME, JR., as director of *Union Carbide and Carbon Corp.* to succeed the late James A. Rafferty, vice president and director.

Three additions to the sales force of *Federated Metals Div., American Smelting and Refining Co.*: ALFRED L. LEE in Philadelphia, South Jersey and Eastern Pennslyvania; EDWARD R. BERGIN, metropolitan New York; ALFRED BLACKSTONE, the Carolinas, Eastern Georgia, and all but extreme Western part of Florida.

DR. HERBERT M. MEYER, editor for Engineering Index, Inc., as an associate metallurgist in the metals research department, *Armour Research Foundation of Illinois Institute of Technology.*

JOHN G. LESCHEN as liaison representative in the field of metallurgy at the *General Electric Research Lab.*

WILLIAM H. TAYLOR, formerly director of engineering and assistant to the president, as general sales manager of *Tinnerman Products, Inc.*

HENRI BARRE, works manager of

A Superior Investment...

"Whip-Mix"* CRISTOBALITE

tops in...
QUALITY
ECONOMY
ACCURACY

- **SMOOTHER CASTINGS . . . STRONGER CASTINGS!**
- **SAVES TIME . . . ELIMINATES WASTE!**

QUALITY: "Whip-Mix" CRISTOBALITE produces finer finished castings due to greater surface density and smoothness of the investment mold . . . has greater porosity . . . eliminates danger of entrapment of air or gases in mold.

ECONOMY: Easily and quickly removed from casting. Completely disintegrates in water. Greater resistance to fracture from sudden thermal change . . . non-hygroscopic and there is no spoilage problem due to storage . . . lower in cost.

ACCURACY: Rigid controls guarantee accuracy of every batch.

QUANTITY: "Whip-Mix" CRISTOBALITE is lighter in weight thereby giving more flasks to the drum.

Use it with present standard equipment and technic. Why not write us today for further information . . . join the long list of satisfied users of "Whip-Mix" CRISTOBALITE now!

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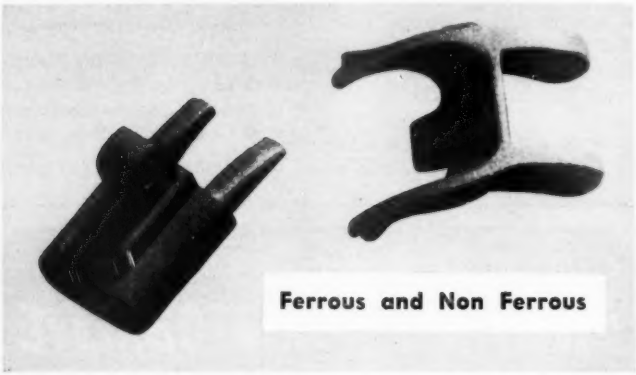
Precision Castings

"LOST WAX" PROCESS



Ferrous and Non Ferrous

For those difficult small parts where dimensions are close and shapes complex, our "lost wax" castings in a variety of alloys may solve your problem. Consult with us and use our experience to your advantage.

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the *Chefford Master Mfg. Co., Inc.*, elected vice president of the company in charge of production.

RALPH BUECHLER as sales engineer for *D. J. Murray Mfg. Co.*, with headquarters at Wausau, Wisconsin.

REFERENCE MATERIAL
continued from page 60

75. PROLONGED LIFE of die casting dies is reported due to Hydrofinish treatment described in literature from Pangborn Corp.

77. BARREL FINISHING LAB for running trials and demonstrations on your castings is explained in a booklet from Roto-Finish Corp.

78. LATEST BARREL PLATING equipment is described in a new catalog just issued by Daniels Plating Barrel Co.

DIE CASTINGS

ALUMINUM OR ZINC

C. M. GREY MFG. CO.

QUALITY PRODUCTS SINCE 1910

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PMM INDUSTRY NEWS

UNIVERSAL BUYS PLANT IN ARKANSAS TO DIE CAST ALUMINUM

Clifford H. Simmons, president of Universal Die Casting & Manufacturing Corp., Saline, Mich., has announced the entry of his company into the aluminum die casting field through the acquisition of modern aluminum die casting plant located in Malvern, Arkansas, near Hot Springs. The purchase price was not revealed.

Universal purchased the plant, assets and equipment of the E. A. Vermere Company, Inc., located near the heart of the bauxite mining and smelting district in Arkansas, bauxite ore being the source of aluminum.

The plant, with 25,000 square feet of manufacturing space, was built in 1950 and is equipped with aluminum die casting equipment, devoted to the production of miscellaneous plumbing equipment, Simmons said. He also stated that the plant has a defense contract with the government to supply shell fuses, production of which will continue under the Universal management.

The purchase of the Vermere plant culminated a steady program of expansion by Universal during 1951. In May, 1951, Universal constructed a new plant in Fowlerville, Mich., for the purpose of manufacturing zinc die cast plumbing fixtures, which was made into a new division of Universal, called Utilex Manufacturing Corp. In June, 1951, Universal acquired a substantial interest in a zinc mine operated in Gunniston, Colo., by the Crested Butte Mining & Milling Corp., and Simmons was elected a director. Later in the same month, Universal purchased a Detroit die casting plant operated by Glenvale Products Co., which is now being operated as a subsidiary of Universal.

Leroy A. Hughes, assistant secretary of Universal, who has been secretary-treasurer and general manager of the Glenvale plant, has been appointed general manager at Malvern.

ALUMINUM INGOTS FROM NEW PLANT

FIRST SHIPMENT of aluminum pig from Kaiser Aluminum & Chemical Corporation's new Chalmette reduction plant at New Orleans began rolling three days after the first aluminum was poured. The new reduction plant is projected as the largest in the United States. C. P. Love, right, is works manager of the Chalmette plant.

CHANGE NAME OF CARBIDE DIVISION

Allegheny Ludlum Steel Corporation has changed the name of its sintered carbide production and sales units from Carbide Alloys Division to Carmet Division. Carmet is the trade name under which products of the division are marketed.

Carmet Division is a principal producer of tungsten and other sintered carbide alloys, having pioneered their use is laminations and other dies for tips for such applications as mining bits. The division has been located at Ferndale, Michigan, on the outskirts of Detroit, since it was acquired by the company in October, 1943. The plant has expanded rapidly since its acquisition and is now undergoing expansion on a large scale.

P. E. Floyd will continue as manager of the division and E. C. Lauck will continue to serve as production manager. Other personnel will remain intact also.

CANADIAN FIRM PLANS TO EXPAND ALUMINA PLANT

A 150 per cent expansion of Aluminum Limited bauxite-alumina production facilities in Jamaica, involving an additional Canadian investment of at least $20,000,000 in the Caribbean area, is now under actual construction, Nathanael V. Davis, president of Aluminium Limited, Montreal, has announced.

Under the new program, the company's Jamaica alumina plant, first in the Carribbean, will have its planned capacity increased from 200 short tons to 500 tons of alumina per day. The increase is required to provide more raw material for Canada's expanding aluminum industry. Further enlargement to 740 tons per day is called for in the company's plans as a successive development, according to Mr. Davis.

DESIGNERS BUILD

Sundberg-Ferar, industrial designers, have announced the expansion of the firm's facilities by the construction of a new and modern building at 1204 South Woodward in Royal Oak a suburb of Detroit.

Now under construction, the building is expected to be completed in July. The single-story building will provide 4,000 sq. ft. of floor space on a site which allows room for further expansion.

Announcing...

FIRST POWDER METALLURGY INDUSTRY DIRECTORY ISSUE

The April issue of PRECISION METAL MOLDING magazine will include — A DIRECTORY OF THE POWDER METALLURGY INDUSTRY. This issue will coincide with the Eighth Annual Meeting and Show of the Metal Powder Association on April 29-30 at the Drake Hotel in Chicago.

For the first time a complete directory will be available on the powder metallurgy industry.

Subjects covered:

(1) A complete fabricators' listing
(2) Raw material suppliers' listing
(3) Equipment and accessory builders' listing

This directory issue is an answer to the hundreds of requests that we have had in recent months for a buyer's guide or central reference for those companies interested in the comparatively new field of powder metallurgy.

The April powder metallurgy industry directory issue will be a valuable part of your working files—be sure to watch for it.

The Editors

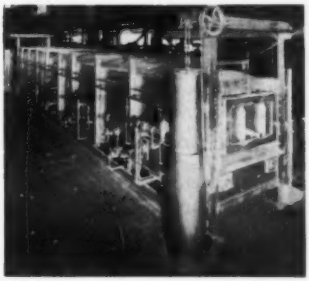
PRECISION METAL MOLDING

1240 Ontario Street • Cleveland 13, Ohio

FORTY-FOOT FURNACE PREHEATS INVESTMENT CASTING MOLDS

The longest standard heat treat furnace ever built in the Toledo plant of Surface Combustion Corporation was recently delivered to Whitehall Precision Castings Division of Michigan Steel Castings Co., Whitehall, Michigan.

This complete double-end furnace, 40 feet long from door-to-door, will be used by this manufacturer for highly critical preheating and thorough dewaxing of molds during their precision casting operations by the "lost wax" process. Five progressive zones each with automatic temperature will insure maximum dimensional stability through controlled expansion of the investment mold.



Transportation problems stemming from the great length of this five-zone furnace necessitated its delivery as two separate sections, which were joined together at the customer's plant. Shipment was accomplished on two flat-bed trucks. One truck holding the first section of 24-foot length and the other the remaining 16-foot section plus an auxiliary charge table.

ELECTROFORMING
continued from page 40

ed parts must be machined externally

Typical applications—Electroformed parts are now being used in various industries, prominent of which are electronics, aircraft, television, motion picture cameras, searchlight reflectors, molds for plastics and phonograph records.

The electronics field uses electroformed waveguide tubing, waveguide elbows, transition tubes, taper tubing, tee sections, antennas and cavities plus various other precision parts.

Spherical, elliptical and parabolic reflectors are electroformed in nickel and copper with a rhodium reflecting surface. The value of a precision metal reflector with a reflecting surface of bright, non-tarnishing rhodium can readily be appreciated.

Perhaps the best known application of electroforming is the phonograph record industry. Here the original must be duplicated and this is accomplished by electroforming a negative and using the negative to press out phonograph records.

Other electroforming similar to phonograph records is the electroforming of master dies to press out television enlarging screens, graining

Accurate Die Castings

Mean Lower Finishing and Machining Costs

The above cam action 'loc-tite' die cast handle assembly, as used on CLEARVIEW glass louver blinds, has proven more popular than rachet or gear operators. One easy half radius turn, and the louvers are fully opened or closed. Louvers are locked in any position by merely pushing in on the handle, and released by the pressure of one finger. It is a definite advantage to the user as many CLEARVIEW customers will testify and we are proud to play our part in its manufacture.

ALUMINUM • ZINC • MAGNESIUM ALLOY DIE CASTINGS

ACCURATE DIE CASTING CO.

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dies for slide rules.

A recent electroforming development is the electroforming of one piece molds for slushing vinyl elastomer doll limbs and heads. Here again the fine detail of the original matrix is reproduced in the mold. Consequently the parts are life like, without a parting line.

Many other associated products are made and can be made by electroforming, taking advantage of its capabilities to produce precision parts with accuracy, detail and high surface finish.

PERMANENT MOLD CASTINGS
continued from page 31

negative side, and that the designer would do well before reaching his final decision, to discuss the particular part in question with a competent permanent mold caster.

What quantity of pieces will be required?

There is no easy answer to this question because the break-even point at which it becomes economical to change from a simpler to a more complex tooling expenditure is influenced by certain secondary considerations. However, the smallest number of parts arbitrarily set as a practical lowest limit for permanent mold casting has frequently been declared to be 500 pieces. Even here, the amount of secondary processing saved must be considerable to overcome the advantage of low tool cost for sand casting.

A production quantity of 5,000 pieces is regarded by most permanent mold casters as a desirable production run and, of course, this does not rule out the possibility of extremely long runs ranging into the hundreds of thousands of pieces. In permanent mold casting, as in die casting, the longer the run, the greater the economy because of the greater spread of tool write-off.

However, in the ultra-large quantities, the designer must scrutinize his secondary costs carefully in choosing between permanent mold and die casting, for here the difference in tool cost is of slight significance compared to secondary machining, and surface finishing costs. If the part can be utilized as cast, or if virtually the same amount of machining and finishing would be required from either a permanent mold casting or a die casting, then the designer must look to another criterion for making a choice.

An average output from one set of molds with multiple cavities is 100 pieces per hour. This pertains to small, non-ferrous pieces not requiring core pulls.

Dimensional requirements and their position relative to the mold

In general, small permanent mold castings can be held within ± .010 per inch, especially where such dimensions fall within a solid portion of the mold. Where the dimension lies across the die parting, or between a solid portion of the mold and a moving part such as a core or slide, the tolerance may be .020 per inch or even as much as 1/32" which is a normal allowance of stock for machining.

The wall thickness of an aluminum permanent mold casting can be con-

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trolled much more accurately than is possible with sand molds, and walls as thin as 3/32″ can be filled without difficulty. In magnesium, 5/32″ is often preferred and for gray iron a 3/16″ wall section should be the lower limit. Because of the uniformity of wall thickness attained, it is often possible for the designer to establish a lower safety factor than is possible by sand casting where greatest variation must be compensated for.

Permanent mold castings are usually cast close enough over-all to facilitate chucking and indexing in a fixture without the problems often encountered with sand molded pieces.

Since the cost of machining represents many times the cost of the casting price in any but the simplest jobs, the ability to cast some of the dimensions which would be most difficult to machine is worth studying carefully. In other cases, especially involving small diameter holes or apertures which would call for slides or cores at odd angles, the machining will involve less cost than the tool investment plus the slower production rate.

What physical and metallurgical requirements must be met?

Due to the greater grain refinement and density resulting from the permanent mold chill, physical properties as much as 20 percent higher can be obtained from a permanent mold casting as compared with a sand casting of the same alloy. Permanent mold aluminum alloys are fully heat treatable.

For pressure tightness, permanent mold castings have a desirable metallurgical structure, with comparatively uniform density between thick and thin sections. The slower cooling and head of metal reduce the danger of cavitation, and the likelihood of entrapped gas is lessened considerably.

Something should be said here of the range of alloys available which can be successfully cast in permanent molds. A wide range of aluminum and magnesium alloys, brass, aluminum bronze and gray iron are being cast on a commercial basis. Mold life, even for these higher temperature alloys, is great enough to be economically feasible, since the metal is poured and thus does not involve sharp thermal impact which would cause erosion or cracking of the die members.

Complexity, size and detail of castings

One limit on permanent mold castings, insofar as complexity is concerned, is that it is dependent upon the straight withdrawal of metal core from cavities in the casting. In this, permanent mold castings resemble die castings.

However, a form identified as "semi-permanent mold" casting is applied to castings produced in metal molds, but using a sand core to shape internal cavities which could not be produced by a metal core. This type of semi-permanent mold casting is common practice, and most commercial molders are equipped to perform this job of making cores and assembling them into the molds. Obviously, this permits somewhat greater internal com-

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With more than a quarter-century of specialization in close-tolerance molded plastics, General Industries has the experience, personnel and facilities to give you prompt, dependable service. No cost or obligation for engineering consultation on your plastic replica requirements.

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plexity than would otherwise be possible.

Variations between thick and thin section present no hazard, except that the conventional good design features of adequate radii and fillets are recommended.

For coring, the diameter of cores should rarely be less than ¼" and complex cores should generally be avoided unless they provide unmachineable recesses or can be otherwise justified on secondary operation savings.

A characteristic surface on permanent mold castings is smooth, but with a slight, readily identified texture. It can often be used as cast, or with mechanical polishing and buffing. For consumer goods, a permanent mold surface is often acceptable with a minimum of treatment, although it can successfully be treated with the same types of organic, electrolytic and chemical coatings which die cast aluminum or magnesium surfaces get.

"BELIEVE IT OR NOT"—*WE ARE*

that we have now "caught up" with our ZAMAK orders and have a limited supply to offer to new accounts. As you know, the initials "H.B.&S." stand for ZAMAK (Zinc Base) DIE CASTING ALLOYS of unsurpassed quality.

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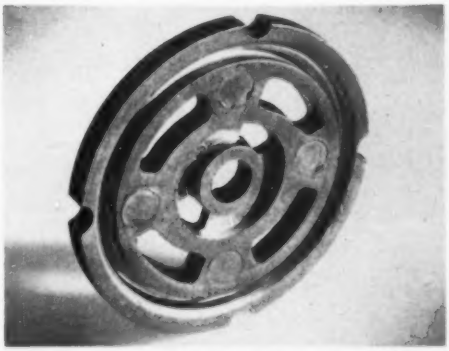
SIMPLIFIED SOLUTIONS

for production problems

SCRAP REDUCTION is one of the most compelling reasons for using powder metallurgy as a fabricating method. Particularly at the present time, this ability of powder metallurgy to produce parts to finish dimensions with practically no scrap loss is of prime importance.

The spring hub for a door closer, **below,** is a good example of this saving. If made from bar stock the weight of stock required to make the part would be 2.54 lbs; as made from iron powder by the Wel-Met Company of Kent, Ohio, the part weighs only 0.52 lbs.

Not only is a large metal saving possible, but the cost of the hub is reduced by almost 50 percent. Porosity of the powder piece allows it to be oil impregnated and hence, self lubricating.



TO WITHSTAND THE HIGH TEMPERATURES inside a jet engine combustion chamber, this thermocouple sheath **below** used for temperature testing has to be made of Inconel. Tubing walls have to be held to .030 thickness. The Investment Casting Company of Newark, N. J., uses the "lost wax" investment casting method to produce them, and makes possible for its customer a 60 percent saving over the previous method of machining the tubes.

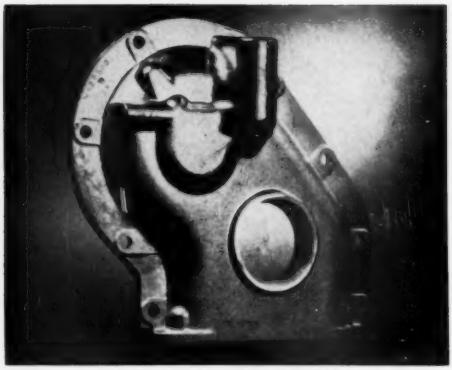
REMOVING FLASH FROM DIE CASTINGS can be a real problem, especially when there are several cored holes from which flash must be completely cleared. The small, circular aluminum die casting, **above,** represented just such a problem for the Dayton Die Casting Co. of Dayton, Ohio, who produce it.

Originally, the casting was cleaned in a compound type trim die, but this was not satisfactory because small metal particles tended to work between the pad and die, making it necessary to remove the die for cleaning too frequently. Since no burr can be tolerated in any of the seven holes, cleaning punches had to be made to fit each cored hole perfectly, and since the castings are produced in an 8-cavity die, it was almost impossible to make each core absolutely identical. Naturally, a slight "whisker" was noticeable in some, while others were completely removed.

Not wanting to ship out castings with any burrs, Dayton Die Casting went to a Wheelabrator Tumblast (27" x 36") for the answer. Using True-Steel shot, they experimented with proper cleaning cycles and decided upon a 2-minute cycle and a small load of 200-250 castings. This did the job perfectly, removing all flash from the surface and cored holes. No flash was turned against the side of the castings and no whiskers were left. Cleaning time: 1 hour and 55 minutes including loading and unloading, to do a job that would otherwise have taken 40 hours (including down time) with the original method.

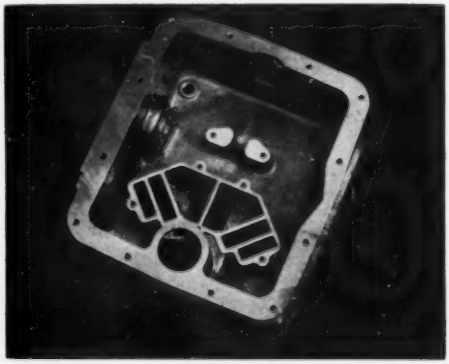
SIMPLIFIED SOLUTIONS

for production problems

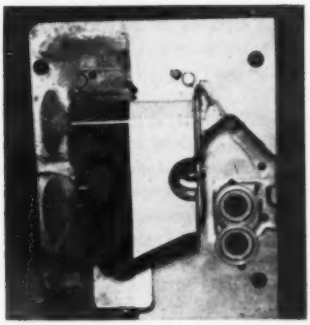


TO OBTAIN A GEAR HOUSING COVER having simple shape, shallow depth, and relatively uniform wall section, it might be thought that sand casting would provide the most economical answer, particularly when the quantities are not high and all critical holes or surfaces must be finish-machined regardless of the casting method used. This is not the case, however. Despite the fact that surfaces must be machined and holes drilled from five directions on the gear cover shown at the **left,** it is considerably less expensive as a permanent mold aluminum casting than as a sand casting. This can be accounted for by the smaller amount of stock removal, the greater simplicity in locating and indexing, and the saving in metal due to the more accurate control of wall thickness. The casting is produced for Continental Motors Corp. by Aluminum Permanent Mold Co., Grand Rapids, Mich.

A 50 PERCENT REDUCTION IN WEIGHT and maximum weather resistance in coastal areas are obtained by using aluminum die cast housings for gas meters. A combination of these two features are built into some models of gas meters by the Metric Metal Works of the American Meter Co., Erie, Pa., by using the three aluminum die castings, **below left.** Weight of the body, an exceptionally intricate casting as revealed by the close-up of one surface, **below right,** is 7 lbs., 14 ozs. Naturally, all valve mounting surfaces and critical holes need to be machined, but internal apertures are cored, as are mounting and shaft holes.



DIE CLEANING METHOD



View of intricate die casting die showing the effect of liquid blast cleaning. Part of the die was masked off during the cleaning process. Although this die has many deep holes and thin-walled sections, it is easily and safely cleaned. The abrasive nozzle used in this case makes a concentrated stream for ease in cleaning holes, but wet blasting affords such close abrasion control (tolerances up to .0001 inch are regularly held) that thin-walled sections are not subjected to any danger of destruction. Very fine mesh abrasives with various characteristics are employed. This die was cleaned in the recently-introduced Liquamatte, a wet blasting machine manufactured by American Wheelabrator & Equipment Corp. of Mishawaka, Indiana.

From One Source

A COMPLETE DIE CASTING SERVICE . . . FROM DESIGN TO FINISHED PRODUCT.

No matter what your die casting requirements may be, Central has the facilities; the equipment, the experience and trained personnel to produce castings to meet your rigid specifications.

Take advantage of Central's complete facilities and be assured of prompt economical service on the best castings made.

- Complete engineering and design service
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ANACONDA ZINC PLANTS TO BE AT FULL CAPACITY

Anaconda Copper Mining Company expects to operate its zinc plants at Anaconda and Great Falls, Mont., at full capacity during 1952, according to a statement from Clarence Glass, vice president of Anaconda Sales Co.

Entire output of these plants consists of electrolytic zinc of which an increasing proportion is produced as special high grade to meet the requirements for die casting.

An additional unit at the Anaconda plant, now under construction, should be completed in 1952, increasing future productive capacity. Substantial expansion in output of zinc ore is also expected from the Butte area beginning in 1953.

ARWOOD BUYS METALMOLD

Rawson L. Wood, president of the Arwood Precision Casting Corp., 70 Washington Street, Brooklyn 1, New York, announced the acquisition of the capital stock of the Metalmold Corp. of Derby, Conn.

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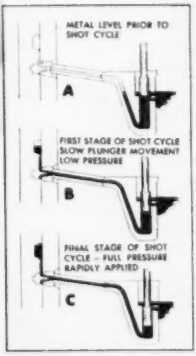
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ADVANTAGES OF DIE CASTING
continued from page 33

secured by a press coining operation on the lower housing member before assembly.

The maximum amount of reinforcing has been built into this lower housing, but to be sure of the necessary rigidity the wall of the part is made ⅛ inch thick. After coining, therefore, both the manufacturer and the user are assured that the motor will always be correctly positioned.

The upper motor housing presented a slightly different set of conditions. While matching members had to be present in the cover portion, provision also had to be made for the slight misalignment that inevitably would occur. This portion, therefore, instead of carrying bearing seats like those in the lower housing is fitted with two spring steel seats so that when the housing is clamped together, the bearings are still free to move if necessary. A small conical coiled spring at the rear of the cover is provided to bear on the gear box cover and hold it in place.

Design to utilize deformation . . . .

Despite the care with which the two housing members are made, the upper and lower halves will not al-

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ways match exactly. Rather than trying cover after cover to secure the desired fit, the wall is made quite thin so that when the cover casting is bolted in place, it will "warp" a small amount to fit the lower portion properly.

The two halves of the motor housing illustrate how, by departing from the usual way of doing a job, the extreme flexibility of die casting can give a better product and as in this case, an over-all cost reduction of 20 percent.

. . . . *and ductility*

Following the same line of thought, the utilization of diecastings to their fullest extent, use was made of the ductility of zinc in the assembly of the fixed member of the oscillating mechanism. This part combines both tilting and oscillating functions. To provide a good wearing surface for the oscillating pin, a sleeve of steel is rolled into a cylinder. This cylinder of steel is cast as an insert in the zinc die casting. A small hole in the sleeve provides adequate anchorage. The wrist pin on which the oscillating crank arm works is a screw machine part.

Casting it as an insert presented a number of difficulties. The die casting was, therefore, made with a tapered hole and a raised flange. In the assembly the wrist pin is pressed into the casting and the flange then bent over into a groove in the pin to form a locking head. The component parts and an assembly are shown in Figure

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3 and a schematic diagram of the assembly in Figure 4.

In other places on the fan the ability to incorporate special masses of metal, mounting holes, or other special features has been utilized to the fullest extent. The fan base is a case in point.

To provide for speed control, Westinghouse uses a flat wire wound resistor on fans that are to operate on 115 volt circuits and a choke on fans that will operate on 230 volt circuits. So that the same base may be used on all fans, mounting devices for both of these control devices are easily incorporated in a single die casting. For the resistor a special mounting was needed to give adequate heat dissipation so that neither hot spots or burned insulation would result. The choke required only mounting holes.

Following the lead of the engineers who developed the new housing for the fans, the Westinghouse Food Crafter also features a horizontally split housing.

5. TO USE THE SAME BASE for many models, various masses of metal have been provided to serve as mounting pads for resistors, chokes, and base cover.

Experience in the manufacture of this appliance demonstrated the desirability of being able to operate the unit without the upper housing being in place so that adequate adjustments could be made at the factory. This necessitated one change in design. In the fan, the upper housing is used to clamp the motor unit in place. In the Food Crafter a specially designed steel clip does this job. The upper housing is, therefore, only a cover and serves no structural function at all.

As in the case of the fan, the adoption of this split housing design has materially reduced the cost of the assembled motor unit.

P. R. MALLORY EXPANDS

A half-million dollar expansion program which will provide new facilities for the Capacitor, and Metals & Ceramics Divisions has been announced by the P. R. Mallory & Co., Inc., of Indianapolis. An additional 35,000 square feet of manufacturing space will be added to the Capacitor Division for the manufacture of electrolytic capacitors.

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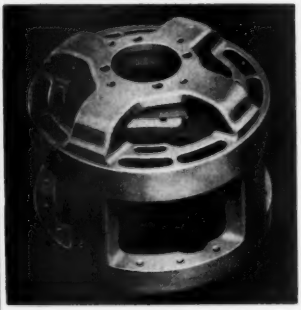

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ZINC INSTITUTE ANNOUNCES ANNUAL MEETING

The American Zinc Institute has announced that its 34th annual meeting will be held at the Hotel Statler, St. Louis, Missouri, on Monday and Tuesday, April 21 and 22.

Present plans provide for a full two-day program with a morning and afternoon session scheduled for both Monday and Tuesday.

Qualified speakers from Washington and from the industry will report on the general outlook for metals and the zinc supply and requirements picture. Mine development and production expansion at home and abroad will be thoroughly covered by a special panel of mining men.

AES MEETING IN JUNE TO BE HELD IN CHICAGO

Industrial Finishing Exposition of 1952 sponsored by the American Electroplaters' Society at the International Amphitheatre, Chicago, will be held June 16-20 concurrently with the AES 39th annual convention.

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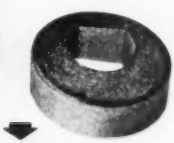

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Materials and methods currently in use as LUBRICANTS FOR DIE CASTING DIES

THE use of die lubricants in the production of die castings is the subject of wide divergence in opinion and practice among casters today. There are those who are vigorously partisan in behalf of one or another proprietary lubricant, while others depend entirely or partially upon home-made concoctions.

Still another school of thought looks upon any application of lubricant to the die surface as a superficial remedy for some breach in engineering practice—die design, temperature regulation, alloy control or some other department of die casting production—which should be rendered unnecessary by proper planning.

The fact that die lubricants are almost universally used by die casters to greater or lesser extent is evidence of the need for some type of lubrication for the majority of jobs. There is no single, all-purpose lubricant which performs satisfactorily with all metals under all circumstances, but the selection of the best ones for each use can certainly be made.

The inconsistent and often contradictory opinions of men in the field reveals a lack of information concerning this important subject.

With this in mind, the editors of PMM have undertaken to gather together data on lubrication of die casting dies. Sources of information include a number of commercial die casters, a consultant in the die casting field, the manufacturers of proprietary lubricants, and recent literature on die casting practice which contains only brief reference to die lubricants.

No attempt will be made to draw final conclusions concerning the comparative merits of various kinds and methods of lubricating; it is apparent that the alloy being cast, end use of the castings, size and shape of the cavity, die and metal temperatures, subsequent processing of the casting, and general shop practices will have a bearing upon the selection of the right lubricant. In most shops, two or more lubricants are used, chosen to meet varying production requirements.

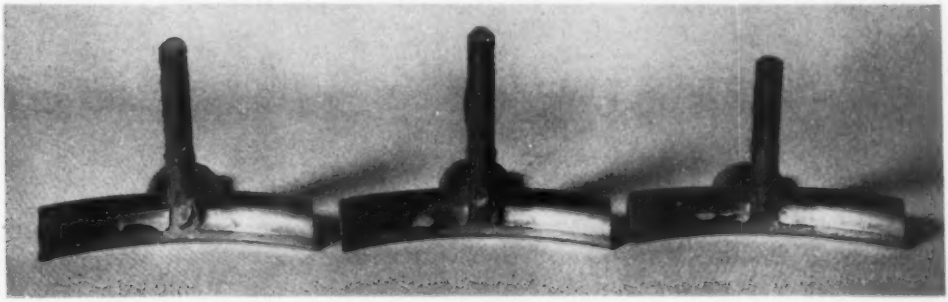
Objectives of die lubrication

There appear to be three primary objectives in applying a surface coating to the die cavity: 1) to prevent sticking of the casting and aid in ejection, 2) to protect the steel die surface by preventing alloying of the die cast metal with the die steel which results in soldering or welding, early die failure, decreased production and poor casting surface, and 3) to help metal flow.

In addition, lubricants are used to condition the die

Three stages in shooting out a "weld" . . .

Three successive stages in shooting out a "weld" are illustrated here. Advice given by the caster is, "Run your die **hot** and use a lubricant that will penetrate between the weld and the die, and also act as a flux between the broken part and the fresh, hot metal. Castings supplied by Western Die Castings Co. of Los Angeles, Cal.



during the break-in period, to overcome excessive drag from inadequate draft and to "shoot out" welds. Special lubricants are also employed to reduce wear on moving parts of the die such as cores, slides and ejectors.

H. H. Doehler has set up nine specifications for an "ideal" die lubricant * as follows:

"1. It should be satisfactory both for the die surfaces and for the moving die components.

2. It should form a tight adherent film on the die surfaces—one that could not be removed by contact with the high-pressure molten alloy.

3. It should require a minimum number of applications in a given time. Obviously, the more times an operator has to apply a lubricant, the less will be his production. If a lubricant need only be applied once in, for example, 10 or more casting cycles, there would be less delay in the production schedule than if the operator had to lubricate once in 5 or less cycles.

4. It should have good surface coverage and be capable of being spread rapidly and uniformly over the entire die surfaces and recessed area.

5. It should not stain the die castings. The effect of some lubricants is not only to promote a poor surface finish on the casting, which in turn gives rise to poor mechanical properties, but also to stain the castings. This stain must subsequently be removed from the casting, usually at considerable expense, and very often stained castings must be rejected and scrapped.

6. It should not attack the die steel. Experience has shown that some saponifiable oils containing fatty acids or glycerides of fatty acids break down at elevated temperatures, thus promoting the formation of more active acids (formic and acetic) that readily attack steel surfaces.

7. It should not fume excessively, give off toxic or objectionable gases, cause dermatosis, or otherwise affect the health of the machine operator.

8. It should not congeal or cake, or build up in recessed corners or on die surfaces.

9. Finally, it should be of reasonable cost. Since large quantities of die lubricant are used, this is an important consideration."

It should be pointed out that chilling is not a function desired of die casting die lubricant, as distinguished from mold coatings sometimes used in the permanent mold field where chilling action may be a primary objective. In this latter field, selective chilling of hot spots in the mold is also practiced by using different coatings for different portions of the mold.

The subject of mold coatings for permanent mold casting will have to be held for a subsequent article, since the methods of application, objectives and types of lubricants vary considerably from those common to die casting.

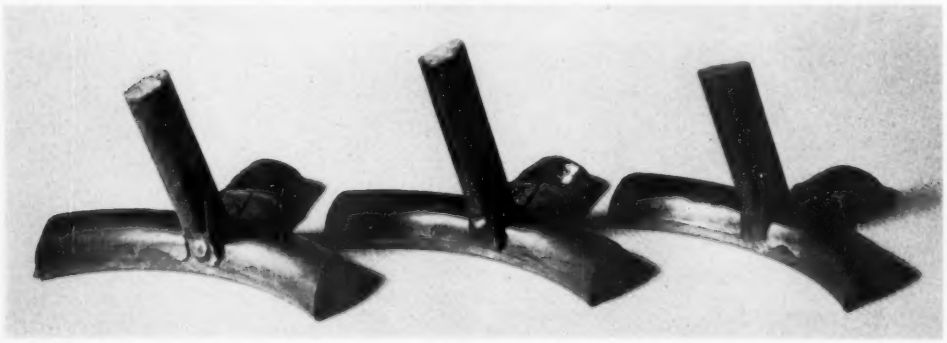
General types of lubricants

Petroleum base lubricants: These make up the base for some proprietary mixtures or are recommended as thinners or extenders for others. Mineral oil lubricants include light machine oils used neat or diluted, heavy cream-like pastes or viscous machine oils brushed on or diluted and sprayed. These are commonly used as convenient carriers for powder-type lubricants, or in emulsions.

Natural or artificial waxes: So-called home-made lubricants are often built around emulsions of beeswax

*By permission from DIE CASTING by H. H. Doehler. Copyright 1951. McGraw-Hill Book Co., Inc.

WITH PART OF THE CASTINGS CUT AWAY, it is easier to see the flaws. The sprues can be seen at the rear and the core was in front where the weld occurred. Where the hot metal first impinged upon the core, after squirting through the gate, it adhered to the core. In the casting at the right, the slug of metal has been picked up by the new casting. Alloy is aluminum No. 13. Both photos are by courtesy of E. M. Scott Chemical Co., Los Angeles, Cal.



or carnauba where zinc is the metal being die cast.

Graphite lubricants: Colloidal graphite in water or oil is widely used as a die lubricant, with the nature of the cavity and the operating temperatures determining the carrier. Some home-made lubricants consist of graphite in a suitable carrier.

Molybdenum sulfide lubricants: While this material offers certain advantages as a high temperature lubricant with excellent surface characteristics, several mechanical handicaps relating to its method of application are, at present, apparently unsolved.

Silicone lubricants: From time to time, engineering reports have suggested the suitability of the silicone lubricants for die casting dies. A check with a manufacturer of silicones reveals no evidence of any production use of this lubricant on die casting dies.

Obtaining a good surface on a casting

The use of lubricants to overcome sticking brings with it problems of

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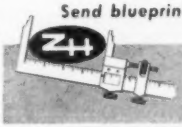

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surface quality. These can be corrected, but sometimes require patience and intelligent planning to select the right lubricant for each set of operating conditions, as well as the use of good shop practice at the die casting machine.

Problems which sometimes arise include staining, surface residues, porosity, oil marking, chilling and flow marks. Where subsequent operations are to include plating, painting or barrel finishing, some of these surface defects must be prevented, although for interior structural parts, these have no effect upon mechanical properties and need not be considered.

Porosity—If too heavy an application of an oily lubricant is used, the next few castings may show some tendency toward pock marking which needs to be polished out before plating. In general, recommended practice is to apply as thin a coating of lubricant as will cover the die face

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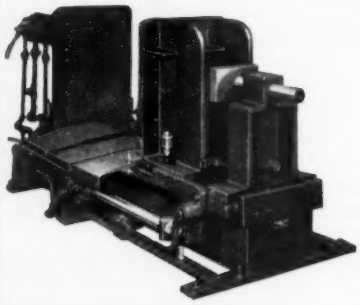

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and resist the washing action of molten metal.

It appears that the flash point of a mineral oil lubricant has an important bearing upon this matter in order that the vaporization of lubricant be dissipated before the injection of metal. One manufacturer produces a pair of heavy oil-type lubricants, one with high flash point to assure a die coating at elevated metal and die temperatures, and the other with lower flash point so that gases will be volatilized and dissipated to produce less gasing and residue for normal zinc die casting temperatures.

Although one die caster has suggested that neither kerosene, gasoline nor other low flash point solvents be used in a die casting die, kerosene is very widely used for thinning and extending commercial lubricants.

A suspension of colloidal graphite in water is available as a proprietary lubricant to be used where gas formation is a problem, inasmuch as water volatilizes before the molten metal reaches it, leaving only the film of inert graphite on the die surface. However, great care in application is required with this type of lubricant because the water suspension coats only the surface to which applied and does not spread over adjacent areas. It therefore has seemed best suited for shallow and relatively simple cavities. Oil suspensions of colloidal graphite are easier to apply to all surfaces, but as in other oil-carried lubricants, care must be taken against too heavy applications.

(To be continued in the April issue of PMM)

CORROSION - RESISTANT
continued from page 38

method of manufacture could produce the parts with the same economy as die casting.

The basket ring segments are drill-

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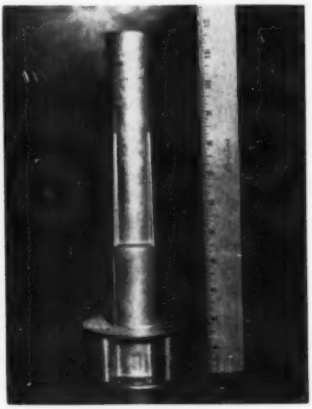
ed and tapped for mounting and then polished. Both operations are inexpensive and require no skilled labor so that the ultimate cost of a die casting ready for assembly is far below competitive methods of manufacture. These ring segments, three of which are used in each basket, present quite a problem to the caster. Because of their length and small section there is a considerable problem of metal flow. On any type of gravity feed casting it is probable that cold shuts would result before the mold was filled. The relatively high velocity of liquid metal flow in die casting helps to prevent this. Die casting offers another advantage in this shaped casting. With a gravity feed system it would be difficult to utilize more than one gate, with die casting two, three or more can be readily used if it becomes necessary.

The basket drive tube, another aluminum die casting, is worthy of note because of its great ratio of length to diameter and thin wall section. The



3. AN UNUSUALLY LONG CORE PULL makes this tubular die casting a difficult one to produce.

ratio of length to diameter is much greater than the caster likes to contend with. Fortunately in this case a considerable draft on the core can be used to aid in its removal. Small though this piece is, from a weight point of view, an exceptionally large press is necessary to secure adequate opening to withdraw the core.

At no place is the wall thickness over ¼ inch so that again as in the case of the basket segments the problem of feeding metal through a long thin section is encountered. All of these problems are economically met by die casting.

As is usual with the Thor Corp., all mating and matching surfaces are machined after the casting is received from the foundry.

This question of machining die castings before assembly is one that faces every user or potential user of die castings. While practice will vary from shop to shop, most designers feel that is is usually better to give the die caster open tolerances and do a

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little more machining, than to hold the foundry to tight dimensional tolerances in order to save some machining.

The problem here is one not only of costs, but also of availability of machines. In most shops, operating under normal conditions, there is machine time available and it is economically more sound to do some extra machining rather than pay the higher cost of more precise castings. However, it cannot be over emphasized that the answer to this question can only be reached by consulation with the die caster.

Thus far, the Thor Corp. has found that relatively open tolerances and a small amount of extra machining work is the best answer. For this reason most drawings for die castings call for ± 0.010 inches per inch from the caster. In the machine shop, the average fit is machined to ± 0.002 to ± 0.005 total tolerance.

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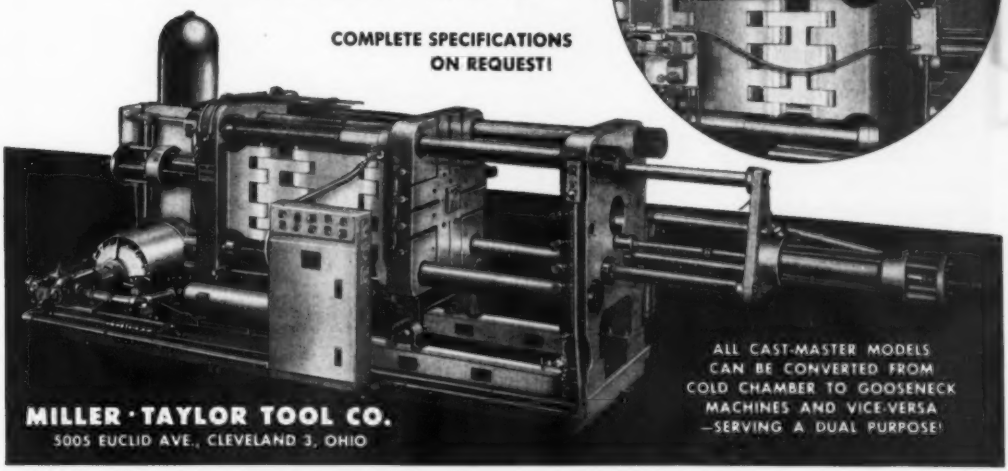

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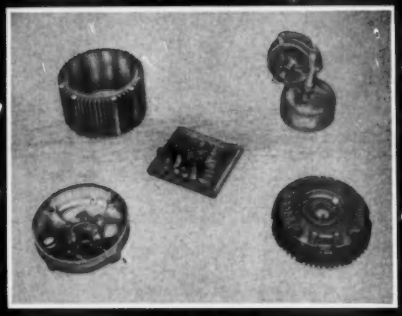
In The

Electrical Equipment Industry Die Cast Parts of Aluminum and Magnesium Alloys Can Play a Vital Part



Typical of parts that are successfully and economically die cast from both aluminum and magnesium alloys are, as illustrated above: electric windshield wiper housing; electronics base part; motor end bells and a motor field ring. Several important factors give ready reasons for this method of manufacturing:

COST: Great savings are effected in labor formerly required for machining and finishing—(most of the holes are cored)—through this precision method for producing an immense variety of parts.

DIMENSIONAL STABILITY: These tough and strong alloys, when die cast, help maintain bearing fits and tolerances.

HEAT DISSIPATION: Parts, such as these, die cast from aluminum and magnesium alloys, give adequate dissipation of heat through the high thermo-conductivity of the parts as compared to other materials. It is easy to design into parts such features as heat dissipating fins.

FREEDOM OF DESIGN: Through die casting, greater scope is offered to the engineer and designer for development of their ideas.

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